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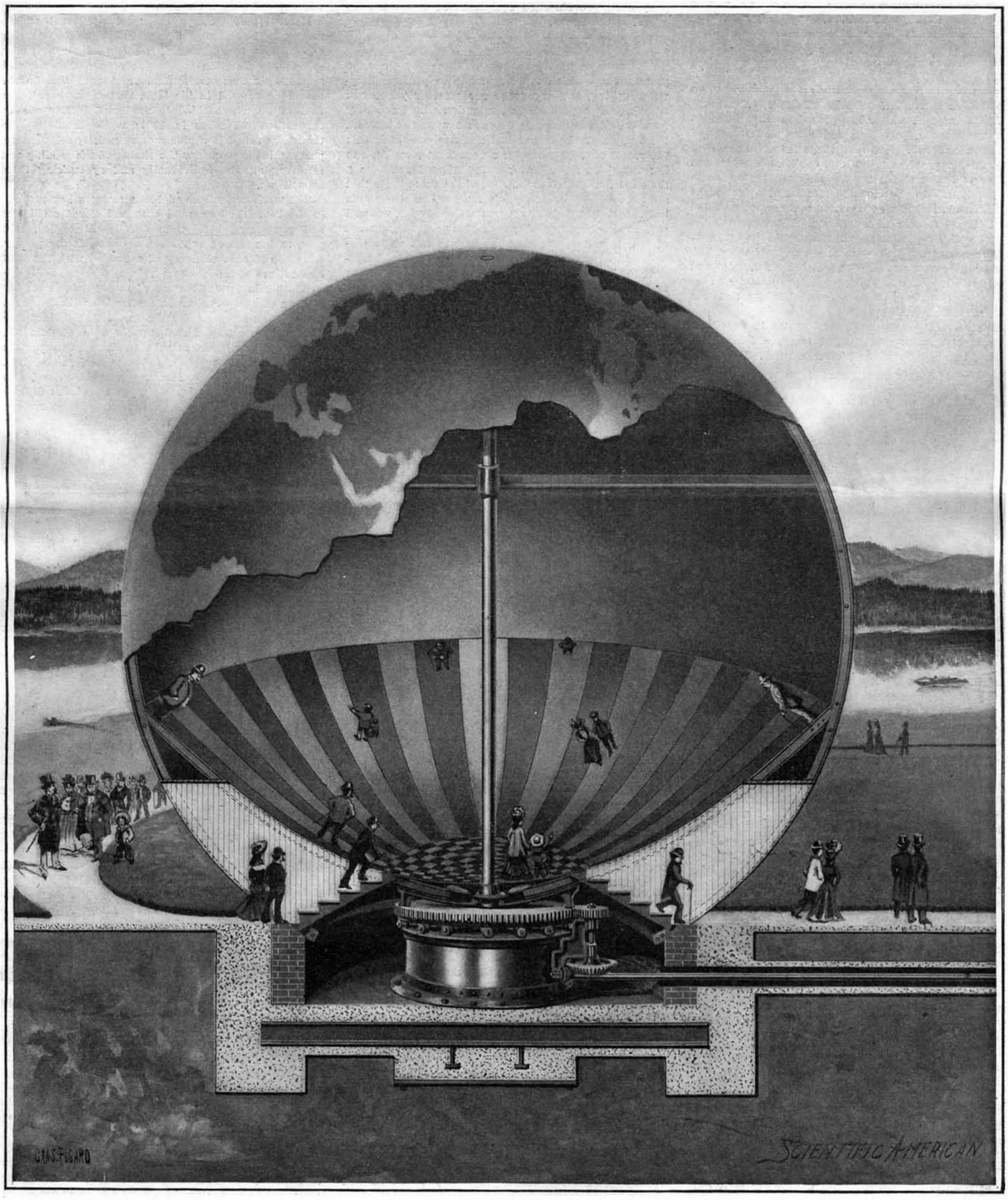
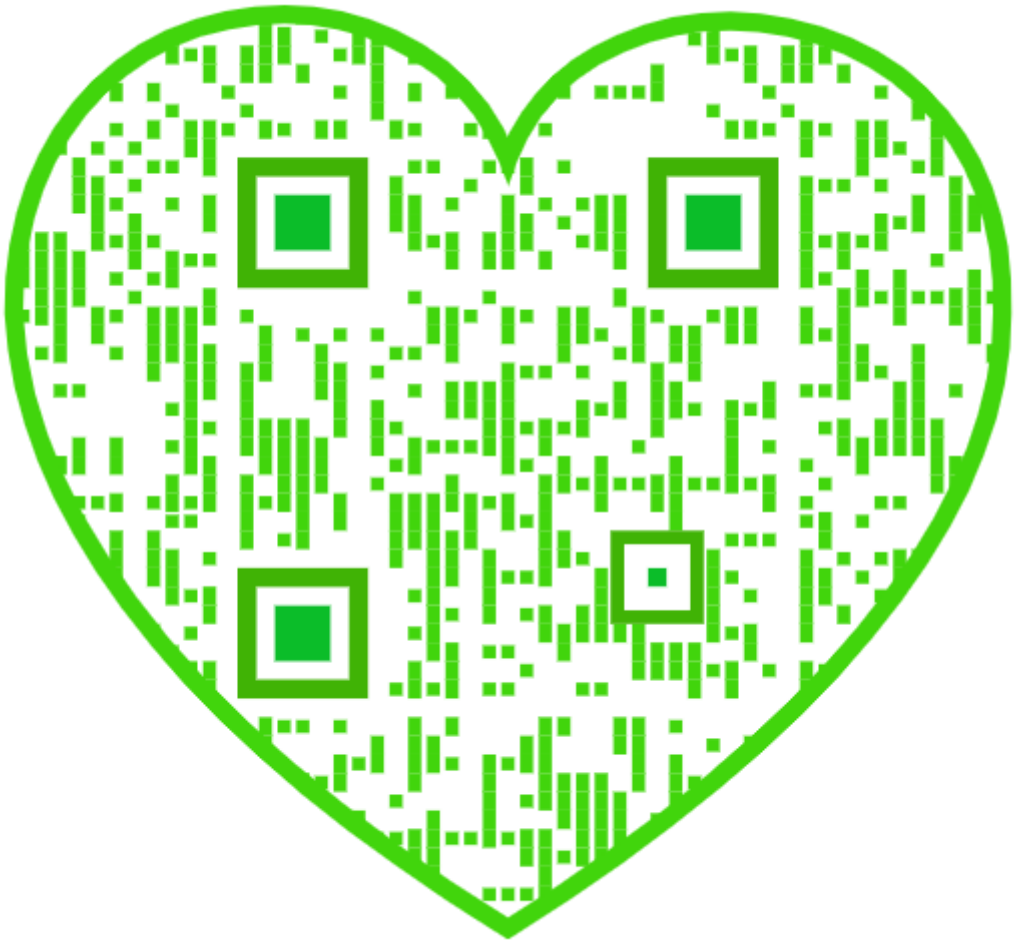


A Parabolic Floor is Rotated at Such a Speed that the Centrifugal Force About Equals the Attraction of Gravitation. As a Result a Man Standing on the Outer Edge Will Imagine that He Alone is on a Dead Level and that the Persons on the Opposite Side Are Walking on a Vertical Surface. If he Moves Across, It Will Seem to Him as if the Entire Apparatus Were Rolling Over With Him Like a Ball Floating on Water. He will Seem Infinitely Heavy; Everybody Else Infinitely Light. Circumferential Walking is Easy; Diametrical Walking Difficult.

THE MAGIC SPHERE.—[See page 493.]



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NEW YORK, SATURDAY, JUNE 16, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

STEEL AND WOODEN CARS IN THE SUBWAY FIRE.

Again the all-steel car has proved its superiority to the wooden car, this time under the double test of collision and fire. Not that the all-steel car needed any further proof as to its high qualities of resistance either to fire or shock, for its behavior both on steam railroads and in the eighteen months of operation of the Subway, had made it clear to every practical mind that it was the car of the future. What renders the recent accident particularly convincing is the fact that of the two cars which were at the ends of the colliding trains, one, a wooden car, was badly shattered and practically consumed, while the other, a steel car, received comparatively little structural injury and was only slightly injured by fire.

The accident was due to carelessness in switching a train of empties onto a third track, which, temporarily, was being used as a storage track. The force of the collision was sufficient to derail the front truck of one car and throw it against the third rail, with the result that there was a heavy short-circuit. The two last cars of the train which was run into were of wood. These instantly caught fire, the first of them being entirely destroyed, and the second car partly so. The damage to the steel car was confined to a portion of the wooden floor and the rattan of the seats, these being the only portions of the car that were inflammable, if we except the window sashes. It would, of course, be desirable to abolish even these inflammable materials, and the steel cars could be rendered more nearly fireproof by constructing the floor of steel plate overlaid with fireproofed hardwood strips, and by substituting steel or bronze sashes in the windows. As for the rattan, which is needed for comfort, it should be possible to treat that with some fireproofing solution.

The burning of these Subway cars has naturally excited some measure of public distrust of the wooden car; while that portion of the daily press which is only and ever seeking what it may condemn, and shutting its eyes to what it might approve, has been censuring the Subway operating company for running any wooden cars whatever on the system. Now, as a matter of fact, the wooden cars which were brought out some three years ago were built with a special view to the prevention of fire, the sides being copper-sheathed, and fire-resisting materials being worked in at all points which are in proximity to the electrical appliances. At the time they were built, they represented the most advanced ideas on fireproof construction. Five hundred of these were ordered by the Subway company two years; and to further insure the safety of the rolling stock and the public, the remaining three hundred cars that were required were voluntarily ordered of the present steel construction. These cars are more costly, are heavier and more destructive to the track, and therefore more expensive in operation than the wooden cars. The fact that they were voluntarily introduced is distinctly to the credit of the Subway company. It has been rumored, however, that with a view to reducing the cost of equipment, no more of the steel cars will be built. We have failed to verify this rumor, and the Rapid Transit Commission would in any case prevent the introduction of more wooden cars into service, the Chief Engineer in his report on the fire having recommended that no inflammable material be used in future cars.

A feature of the recent fire that excited much apprehension was the immense volume and pungent character of the smoke that resulted from the burning of so much insulated material, grease, and painted wood. Naturally this was strongly suggestive of the terrible fire in the Paris Subway, a few years ago, when so many died of suffocation. The public, however, need have no apprehension on this score, if the system of ventilation which the Rapid Transit engineers have designed be installed throughout the system; for it will render it possible to renew the whole atmosphere of the tunnel so quickly, that the smoke of a fire could never accumulate to the point of suffocation. This is a feature of the ventilation improvements which, of itself, would be sufficient to justify all the expense.

In an official report to the Rapid Transit Board, Chief Engineer Rice made the following recommendations:

1. That no parts of cars used in Subway service should be constructed of inflammable material.

2. That an adequate fire-line service should be installed throughout the whole subway, so that water can be had at interior points.

3. That means should be provided for quickly removing the smoke from the Subway in emergencies.

The question of the authority of the Board to compel the operating company to carry out these regulations is dependent upon the interpretation the courts may put upon the contract stipulation that the company shall provide such equipment as meets the approval of the Board.

OCEAN RACES FOR SMALL BOATS.

Although we are thoroughly in sympathy with the present effort which is being made to promote deep-water sailing, and encourage our amateur yachtsmen to gain that experience in navigation which can only be obtained when one is dependent upon the sextant, the compass, and the nautical almanac, we think that the recent offer of a cup for a race from New York to Bermuda was a case of pushing a good principle a little too far. The fact that two of the three boats that started made the trip in safety must not shut our eyes to the fact that the venture was attended with unusual risk of disaster. In the eyes of nine yachting men out of ten, it will appear that the restrictions as to size were placed entirely too low for a race of this character. While we have every admiration for the pluck and skill of the skippers and crews of the thirty-eight and twenty-eight-foot boats which completed the race, we cannot but think that the starting of such a diminutive craft as "Gauntlet," whose length on deck is only twenty-eight feet and her water-line length about twenty-two feet, was an altogether needless imperiling of the lives of the four amateurs that formed her crew.

The facts which rendered the trip particularly hazardous are that no professional was allowed on any of the boats; that for hundreds of miles the little yachts were far from any port which they could make, in case of the carrying away of spars or dismasting; and that they were out of the regular line of steamer travel. A strong hint of danger was given shortly after the start of the race, when one of the yawls carried away one of her spars, and was detained two days in port before she could be put in shape for another start. As we have said, we are fully alive to the advantages of ocean races, such as that over the outside course off the Long Island shore, or the race held last year from New York to Hampton Roads. Here, in case of disablement, some port is always within reach, or the small craft, if disabled, will probably be spoken by passing ships.

The performance of the winning boat "Tamerlane," a yawl measuring thirty-eight feet on deck, which also won the last year's ocean race to Hampton Roads, was extremely creditable to the boat, her crew and her skipper, who by the way is the editor of our esteemed contemporary, The Rudder. She averaged over the whole course between five and six knots an hour, and the publication of the log of the little craft will be awaited with much interest in the yachting world.

A DECADE OF WIRELESS TELEGRAPHY.

Wireless telegraphy is now ten years old. On the 2d of June, 1896, there was filed in the British Patent Office a provisional specification "for improvements in transmitting electrical impulses and signals and in apparatus therefor," by one Guglielmo Marconi, residing at No. 71 Hereford Road, Bayswater, England.

At the time this patent was applied for the art of transmitting messages without wires was wholly unknown, in so far as its practice and utilization were concerned, and the drawings and description of the improvements cited gave neither the layman nor scientist an inkling that the arrangement was one of the most important since those first brought out in the allied classes of telegraphy and telephony, or that the young inventor was destined to take rank with Morse and Bell as a genius who had materially advanced civilization by devising a new means for the transmission of intelligence.

Exactly a decade has elapsed since the filing of that memorable patent, and the great and far-reaching progress made in the art in the brief period past is well known. There are, however, some salient features that have been brought out in the development of the new telegraphy that are not so well known, and to these attention may be appropriately called at this particular time.

After the first successful trials were made across the Bristol Channel between Lavernoch and Flat Holm, a distance of 3.3 miles, by Marconi, and during these notable tests, in which he became cognizant of the great value of using high aerial wires and earthed terminals, the feasibility of telegraphing through space without wires by the Hertzian wave method could no longer be doubted, and all other schemes for producing similar results were abandoned.

Notwithstanding the favorable issue of the experiments, there was yet much to be done before the system could be made commercially practicable, and the young inventor labored zealously to extend the limitations that hemmed it in on all sides. Nor was he alone now in the great work that confronted him, for numerous investigators on both sides of the Atlantic became imbued with the possibilities the new art offered. To increase the range of signaling was the first and most important step, and after that, the desirability of securing selectivity, so that a number of messages could be sent in the same field of force without suffering extinction.

Marconi was perhaps the most persistent experimenter in the bridging of greater distances, while very early in the development of the new telegraphy Lodge turned his attention to the production of a selective system by means of electrical resonance. The former succeeded so well in his task, that from three miles in 1897 he was enabled to send and receive signals three thousand miles in 1904; while the latter, although he failed to evolve a commercially selective apparatus, led the way for the timing of the sending and receiving circuits individually and syntonizing them collectively.

The work of Lodge and his successors has resulted in the beautiful compound open and closed oscillators and resonators, both close and loose coupled, that give, in the refined apparatus we have at the present time, the highest efficiency of operation with the least expenditure of initial energy.

Another important feature of recent date is the utilization of auto-detectors in connection with telephone receivers as receptors for the translation of incoming electric waves into the alphabetic code of dots and dashes. This adjunct may be attributed to American ingenuity, and was a difficult but well-taken step leading toward the goals of accuracy, rapidity, and simplicity, for it eliminates virtually all of the difficult adjustments found in the coherer and Morse register receptors, permitting a very great increase in the speed of reception, and greatly reduces the number of essential parts of the equipment. De Forest was probably the first in the commercial field to use the auto-detector and telephone receiver, while Fessenden has conferred a lasting benefit upon science and humanity by his ingenious detector, the liquid barretter, an instrument that in its sensibility, its ruggedness, and its simplicity is second only to the telephone receiver of Bell.

With these improvements, chiefly made within the past five years, wireless telegraphy is all that the most exacting critic could hope for, if we except selectivity, and in this especial branch of the work there is yet unlimited opportunity for the wireless inventor to exercise his ingenuity.

So much for the physical advances made during the past decade, in transmitting messages without wires. Its usefulness as a commercial factor has been universally recognized, and not only has the mercantile marine service been very largely equipped, but the different governments are fully alive to its possibilities in time of peace and war. Not only have the ships of the world's navies and strategic shore stations been equipped with some make of apparatus, but the armies of various countries have used it overland with considerable success.

Overland wireless telegraphy has been tried out commercially within the past few years; and while it is practical from the viewpoint of operation, the interference between stations leaves it a poor competitor of the wire system. It has competed more successfully with the shorter cables, and elaborate experiments are now being conducted by Prof. Fessenden and Dr. De Forest, working independently in the effort to establish permanently transatlantic cableless telegraphy. Should the results prove practicable, it is extremely doubtful if they will in any way affect the cable companies, as is popularly supposed.

The wireless patent situation has been aired in the United States courts to some extent, and it would seem from the decisions handed down that the claims of Marconi in his original patent of ten years ago, i. e., "a receiver having a sensitive tube or other sensitive form of imperfect contact capable of being restored with certainty and regularity to its normal condition," will be upheld during the life of the patent. As a matter of fact, the electrolytic detector or barretter of Fessenden comes under this claim, although this question has not been answered by process of law.

The present indications are that there will be no litigation between the Marconi and Fessenden interests; and in so far as the United States is concerned, there is reason to believe that of the several companies now making and selling apparatus, many will be driven entirely out of the business, one or two will be allied with the Marconi company, and the fittest only will survive, forming a parallel with the inter-

esting case of the Bell telephone of thirty years ago. If this should prove true, it will show not only the value of fundamental patents, but that which is of equal importance, namely, to have the claims so drawn as to properly cover both methods and apparatus.

THE NEED OF A PURE-FOOD LAW.

BY CHARLES RICHARDS DODGE.

The disclosures of the unsanitary methods in use at Western packing houses, recently brought to the attention of the President and now sought to be controlled and remedied by special governmental inspection, as provided in the Beveridge amendment to the Agricultural Appropriation bill, lately passed by the Senate, will, if concurred in by the House of Representatives, bring about a wholesome check on the preparation of improper products for human consumption.

The fact that the proposed law covers the preparation of only a small part of our foods seems to have been wholly lost sight of. What is true of such meat foods as are derived from cattle, sheep, goats, and swine (chiefly canned and prepared meats or lard) is equally true of a great range of other foods, such as fowls, game, fish, and eggs, and a vast number of non-flesh or fish foods, none of which are in the least protected by the Beveridge amendment, and which may in an equal degree become sources of danger to food consumers. It is not generally known that a proper pure-food law has been before Congress for some time, but it has not progressed as rapidly as its friends had hoped.

The pending bill on meat inspection fails to provide for the official examination of storage foods, such as fish and game, sometimes kept for a period of four or five years in cold storage.

As everybody knows, the prevailing custom in dressing poultry for market is to retain the viscera and contents. In market parlance such fowls have not been "drawn." It is possible—it is a fact—that the changes in the viscera and unremoved contents will in time impregnate the entire flesh of the fowl, and to overcome the very perceptible effects of the changes which have been produced after long storage, a certain "purification" with chemicals must be resorted to before the poultry can be put upon the market. Such treated fowls are common.

The many cases of ptomaine poisoning that are reported, and which are often directly traceable to the use of canned fish or shellfish, are caused by unwholesome conditions for which the packers are responsible. If the product has not been properly sterilized when first put up, in time the fact is made evident by a bulging outward of the ends of the cans. These "blown" cans are repunctured to let off the gases of decomposition, and the contents treated with some preservative solution, such as benzoate of soda, after which they are resealed and put upon the market, to be sold to the consumer as wholesome food, and at the prices of wholesome food. At the Paris Exposition, where the writer had charge of the American food products, we frequently found these blown cans.

There is a stringent law which prohibits the importation of liquid eggs; that is to say, eggs removed from the shell and shipped to us in bulk from other countries. Formerly large quantities of such eggs, preserved with salt, were shipped in barrels from China, to be used in the tanneries. As new methods in the preparation of leather came into vogue, the demand for liquid eggs for the purpose declined. They were then shipped to us as food for human consumption, but preserved with boracic acid instead of salt, the bakeries being the purchasers. While liquid eggs are now excluded from importation, there is no law to prevent the sale of liquid eggs produced in our own country, and large quantities of "broken" eggs, and even malodorous eggs, treated to remove the odor, are sold to the bakers. Can any one say that a stringent federal law is not needed to correct such an abuse?

In the matter of tomato catsup, while it can be prepared without preservatives by proper sterilization, the fact remains that preservatives as a rule are necessary. The tomatoes, coming to the factory in larger quantities than can be worked up immediately, begin to decay; they are accessible to swarms of flies, and after none too careful sorting the pulp is placed in barrels, where in time it loses color, and it not only becomes necessary to use preservatives, but coloring matters as well, or the public would not buy the bottled product.

Among the many baking powder adulterations may be mentioned ground stone. A powder of this description, recently placed on the market, was enlarged under the microscope 120 diameters. The adulteration amounted to over 25 per cent.

Much of the so-called gluten flour sold on the market is either adulterated with wheat flour or is not gluten flour at all.

While there are a few instances of injurious food adulteration, there is a large class of adulterated foods that may not be deleterious to health. They may have been prepared in a cleanly way, and appear quite as appetizing as pure foods; but if they lack nutritive value, by means of certain manipulation, or substitution of cheaper substances, or by the abstraction of any valuable or necessary ingredient, such foods are sold claiming to be what they are not.

When the public health is so menaced, it is time that a proper pure-food law should be put upon the statute books, with ample provisions to carry it out.

THE BRITISH NAVAL PROGRAMME FOR 1906.

The estimates for the British navy during the forthcoming twelve months ending March 31, 1907, show a further diminution, the reduction amounting to $7,500,000 over those of the previous year. The result is that within two years there has been effected a reduction of $25,000,000 in the naval expenditure of the country. For the present year the appropriation is $159,337,335, of which total $46,260,655 is to be devoted to the construction of new vessels, representing a saving of $1,865,350 under this heading.

Though the programme does not contain any sensational features, yet at the same time it illustrates the active work of reorganization which is at present being carried out in all the departments relative to the naval organization, and several economies have been effected. One of the most notable features of this revising policy is the withdrawal of all the subsidies to the mercantile shipping companies for armed merchant cruisers, with the exception of the Cunard Steamship Company, whose whole fleet is still to be retained at the disposal of the Admiralty, and the steamers of the Canadian Pacific Railroad Company, the contract in regard to which has not yet expired. By the abolition of these subventions a sum of $606,900 will be saved.

In regard to the new constructional programme for the ensuing twelve months, the following thirty-three vessels are to be laid down: Armored vessels, 4; ocean-going destroyers, 5; coastal destroyers, 12; submarines, 12.

In comparison with former years this is a somewhat modest programme, but as was pointed out in the SCIENTIFIC AMERICAN a few weeks ago, the Admiralty had decided upon a restricted naval construction policy for the present, to be increased if the exigencies so demanded; and although the administration has since changed, the new government evidently intends to proceed on somewhat similar lines.

In addition to the foregoing, however, there is at present a formidable programme in hand, since the following vessels are at present under construction: Battleships, 6; armored cruisers, 10; coastal destroyers, 12; ocean-going destroyers, 5; destroyer special class (very fast ocean-going), 1; submarines, 15; total, 49; and a new royal yacht and repair ship.

The construction of the recently-launched battleship "Dreadnought" is to be pushed forward with all speed, so as to be ready for commission early next year. In the estimates no particulars of this vessel are vouchsafed beyond the estimated cost, which is $8,987,485, and the fact that it will be ready for sea within fifteen months of the laying of the keel. With regard to the destroyers, the coastal type are to be of 26 knots speed, while the ocean-going craft of this class are to attain a speed of 33 knots. The construction of the special fast ocean-going destroyer has not yet been commenced, though the contracts have now been completed and the work will soon be in progress. This vessel is purely experimental, the contract speed on trial to be 36 knots per hour. The submarine vessels are well under way, so as to be ready for the six submarine bases established round the coast and which are now in course of erection.

During the past year the navy has been augmented by 49 vessels made up as follows: Battleships, 3; armored cruisers, 8; second-class cruisers, 1; scouts, 8; destroyers, 16; submarines, 13; total, 49.

No details are advanced concerning the type of vessel to be adopted in connection with the four armored vessels authorized in the programme for the present year. Two, however, are to be constructed in government dockyards, and from this fact, together with the fact that considerable alterations are to be carried out at Portsmouth dockyard in connection with the shipbuilding berths and facilities, it is believed that they will be modeled upon the lines of the "Dreadnought." This hypothesis is supported by the speed with which this vessel is being constructed, so that actual data regarding the advantages of such a fighting unit in practical operation may be gained, and thus form a tangible guide in the construction of future battleships; while the fact that heavier sums are to be expended upon armor plates and guns, amounting to $1,059,085 and $500,000 respectively, tends to support this view. The speed with which the construction of the "Dreadnought" is being carried out, however, fulfills another important factor. By this experiment the Admiralty will be able to obtain conclusive data concerning the shortest time in which such a vessel can be constructed, so that should any other power embark upon an abnormal shipbuilding programme, the Admiralty, owing to their unique position for rapid construction, would be able to supersede the other power's efforts, and thus have a superior fighting unit in commission at the same time. The British authorities have boldly stated that the policy in future is to be a waiting one, in the sense that they can either, in the government or private dockyards, construct and pass a vessel into the active fleet in half the time required by other nations.

With regard to the present estimates, there is one very prominent fact, and that is the small amount of information that is being conveyed therein to the public, though it is apparent that widespread alterations and improvements have been effected all round, conducing to the greater efficiency of this first line of defense. In regard to the guns, numerous improvements have been effected in the latest patterns of breech-loading weapons. Steel of a greater tensile strength and higher tenacity has been introduced, both for the construction of new guns and the repair of the older types. The sighting arrangements have also been completely overhauled, and the re-equipment of the fleet in this direction is being carried out as rapidly as possible.

With regard to liquid fuel, the Admiralty state that this is being extensively developed. The torpedo boat destroyer "Spiteful," which is fitted with oil-firing apparatus exclusively, is being employed as a training ship for the engine complements in the manipulation of the oil-burning apparatus. Four of the present battleships in commission are equipped with this steam-raising system, while those already in operation in two other battleships are being replaced with the latest type, and all the vessels now in course of construction and nearing completion are to be similarly equipped.

The forthcoming year will, however, rank as an important one in the annals of naval shipbuilding, since it marks the passing of the reciprocating engine and the introduction of the Parsons marine turbine. The Admiralty state that the success of the numerous and severe experiments with this propelling machinery in the cruiser "Amethyst," combined with the results attained therewith in the case of the mercantile marine, is such that all the vessels authorized in the programme for the coming year are to be fitted with turbine machinery.

Wireless telegraphy also is to be developed on a considerable scale as a means of communication between vessels. All the stations round the coast are now exclusively operated by the coastguards. During the coming year three further stations are to be established. In this connection it may be pointed out that the naval authorities are experimenting with a new system, which it is anticipated will become highly successful. During the recent maneuvers communication was established between the various vessels over a distance of 2,000 miles, with complete satisfaction under the most difficult conditions.

Extensive alterations are to be carried out at the Portsmouth dockyard, which constitutes the premier naval station, and which will involve an outlay of $12,500,000. These improvements have become imperative in view of the rapid increase in the dimensions and displacement of modern war vessels. The building slip upon which the "Dreadnought" was constructed is to be lengthened, so as to be able to accommodate vessels up to 700 feet, for some of the latest warclads will exceed the "Dreadnought" in length, while two new repairing docks are to be constructed. At present there is only one dock in which the "Dreadnought," owing to its great size, can be berthed. The two proposed new docks will be each 700 feet in length, so that there will be adequate provision for future developments in warship construction. The improvements in this connection which have been in progress for some years past at Devonport, the second dockyard, have now been completed. One battleship is to be constructed at least every year at Portsmouth, and the time limit imposed for such work is to be two years.

STEAM JACKETING INVESTIGATIONS.

The following conclusions are announced by A. L. Mellanby in an article on Steam Jacketing published in the Inst. Mech. Engin. Proc.: (1) With such an engine and a boiler pressure of 150 pounds per square inch, the best mean pressure referred to the low-pressure cylinder is about 40 pounds per square inch. (2) The jackets have their maximum efficiency when the whole of the high-pressure and the ends of the low-pressure cylinders are jacketed with high-pressure steam. (3) The total indicated horse-power is slightly reduced when jackets are applied to the high-pressure, but considerably increased when they are applied to the low-pressure cylinder. (4) Jackets have little effect on initial condensation in the high-pressure, but considerable effect when applied to the low-pressure cylinder. (5) The temperature cycle of cylinder walls next to the steam is considerably less than that of the steam. (6) The greater part of the missing quantity is due to leakage and not to initial condensation.

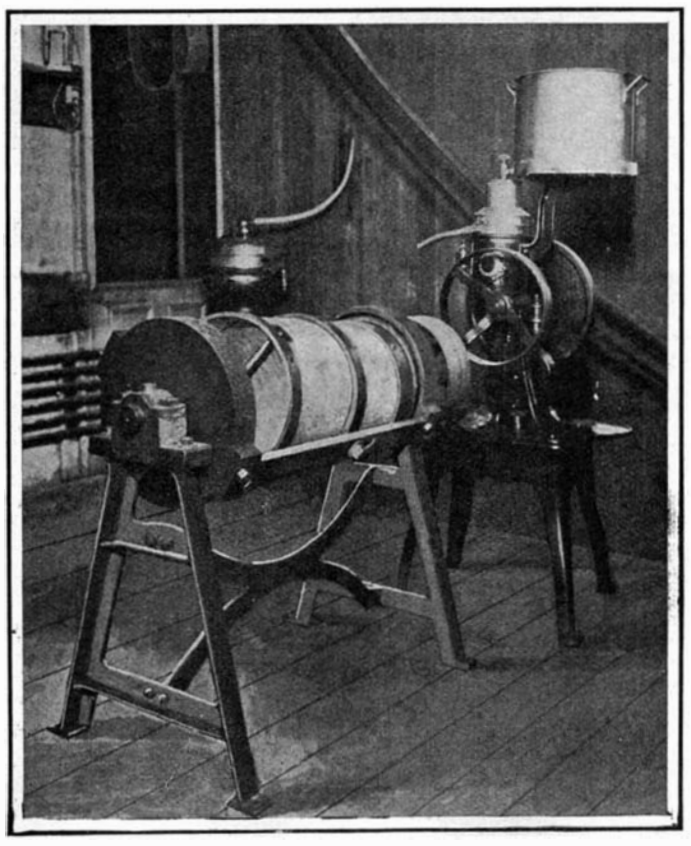
DRIED MILK--A NEW PROCESS.

The idea of using desiccated milk for commercial purposes is by no means a novel one. In fact, for years the general public has been familiar with a partially desiccated or dried product in the form of condensed milk. The latter is nothing more nor less than milk in which the water has been partly evaporated, and which could be completely dried out by carrying the process of manufacture further. Completely dried milk, desiccated milk, milk powder, milk flour, or whatever the term is under which it may be known, is nothing other than ordinary milk from which the water has been completely eliminated by evaporation, leaving merely the solids, salts, fat, and sugar, which the liquid carried in suspension. Within recent years a number of processes for drying milk have been evolved both here and abroad, and these have been successfully exploited in various countries. Among these processes is the so-called Just method, in which the milk is thrown upon steam-heated metal rollers in the form of a very fine spray, and is thereby almost instantly converted into a thin crust which is subsequently removed from the metal by means of fixed blades and is then powdered. The objectionable feature of this and other methods employing high temperatures is said by experts to be that the chemical constituents are changed by the heat, and that even if finely ground the resulting powder is never entirely soluble.

An interesting method for the production of milk flour has recently been developed and covered by patents, which makes no use of high temperatures and in which numerous advantages are claimed for the resulting product. The accompanying photographs illustrate the apparatus which is used in this process. It is said that the cost of manufacture will be extremely low, for the plant can be located in the immediate neighborhood of some large dairy, and thus make use of the skim milk from the latter. This skim milk is often practically a waste after the cream has been used for the making of butter, and as such is either discarded or sold to farmers as hog food. Consequently it is possible to obtain it at small cost, and as the expense of manufacture is nominal, the product can be supplied to the public at low rates. Unskimmed milk can, of course, also be desiccated, but as the cream or fat becomes rancid within a few days, the product in that case is not capable of storage or shipment unless packed in hermetically-sealed receptacles. If the process is to be utilized for the manufacture of condensed milk, the evaporation is stopped when the liquid has obtained the required density. This condensed milk, however, differs from the usual article in that it retains all the properties of the raw milk, unchanged, and need have no added sweetening or preservative chemicals to make it available for daily consumption.

The milk, from which the cream has been previously separated, is run through a centrifugal clarifier, which removes all floating impurities and foreign substances; the liquid is then allowed to cool below the temperature resulting from the action of the clarifier, and is then placed in open receptacles, from which it is drawn into the desiccator. The latter consists essentially of a large, closed copper vessel, provided with glass peepholes through which the progress of the operation may be watched, vacuum gages, and thermometers. A large pipe rises from the top of the copper vessel and leads to a cylindrical condenser, in which is arranged a coil or worm of small piping. Between the condenser and the desiccator the large connecting pipe is provided with a trap, to prevent the accidental return of any of the evaporated and subsequently condensed liquid to the vessel. A strong vacuum pump communicates with the desiccator through the condenser and the connecting pipe.

When the milk is ready for drying the vacuum pump is started, and this creates a partial vacuum within the copper vessel. The end of a rubber tube in communication with the latter is now introduced into the receptacle containing the milk, and the liquid is then rapidly drawn into the desiccator by means of the vacuum within the same. The pump continually draws off the vapors during the entire operation, which lasts from three to four hours, and it maintains the partial vacuum in the desiccator during this period. The action is thus analogous to boiling off the water, though the temperature of the milk is maintained at a point under 105 deg. F. To the eye the operation is indistinguishable from a direct boiling of the milk by means of the application of heat; but it is claimed that by this absence of heat the chemical properties of the milk are not altered in the least, notwithstanding that the process removes impurities and destroys all the harmful bacteria. The vapor is changed to liquid form in the condenser, where it is cooled by a flow of cold water through the worm located within it. From the condenser the liquid, which has been shown to be chemically-pure distilled water, flows into a tank provided with a gage glass, by means of which the amount evaporated can be accurately estimated, and thus the progress of the operation may be checked by the amount of the condensed water. When the milk has been sufficiently dried, the moist white, flaky solid is removed from the desiccator through a suitable opening in the bottom. It is then placed on flat pans, and completely dried by means of a blast of cool, dry air.

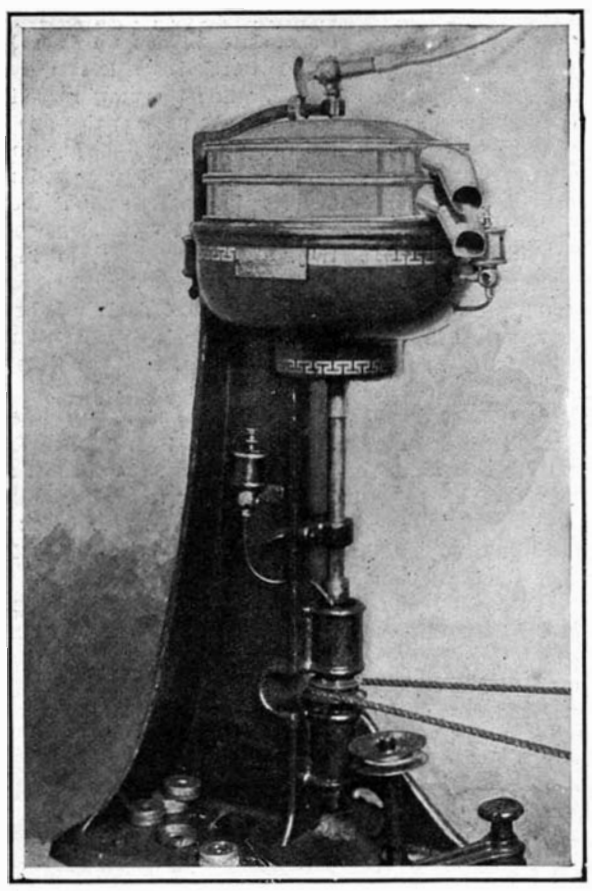


The Cylinder in Which the Milk is Ground to Flour.

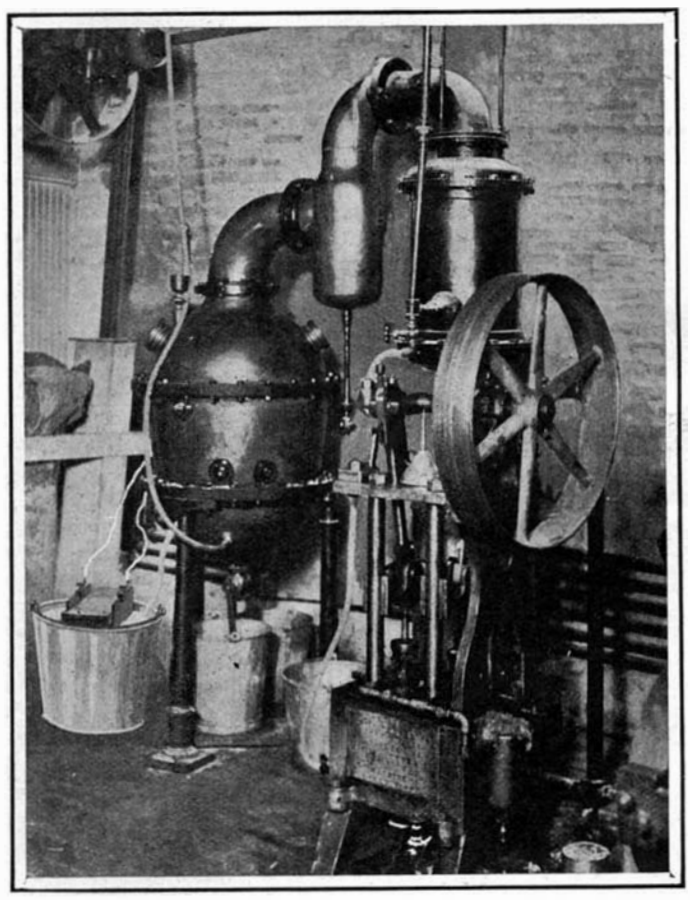
An interesting and unusual feature of the process takes place while the milk is being drawn into the desiccator. Pairs of separated carbon electrodes are introduced into the receptacles containing the milk, and a low-voltage electric current is passed through the liquid. The exact action of the current is not understood, but it is believed that it breaks up the lactose or milk sugar into two separate sugars, which have a combined sweetness greater, or at any rate more apparent to the taste, than the sweetness of the lactose itself. In consequence, the dried milk, if used for cooking or baking, requires the addition of less sugar than normal milk. It will be noted that the dried milk obtained by this process is almost pure white and odorless, while that resulting from certain of the heat-employing methods is yellow and has a distinct smell of cheese, due to the cooking and coagulating of the albumen of the milk during the operation.

The crusty mass of the dried milk is ground or powdered by being placed in a revolving metal cylinder, which contains a number of porcelain balls. These are tumbled about by the rotation of the cylinder, and soon reduce the milk solids to a fine flour. This is very nearly soluble in water, and it is possible to reconstitute the desiccated liquid milk by the addition of the requisite quantity of water to the flour. The reconstituted milk, while it has all the exact properties of real milk, has a flat taste and is, of course, not as palatable as the original article. The great value of solid milk lies in its use in baking and cooking, or for certain commercial purposes. Thus in the manufacture of milk chocolate, which is so popular at the present time, the maker is limited in the quantity of milk which can be added to the ground chocolate, because the resulting mass must not be too thin or the chocolate will not harden properly. No such difficulty is present if milk flour is used. As it will keep indefinitely, it should prove invaluable to tourists, campers, explorers, and for military and naval purposes, not only as a powder but in tablet form as well. Its use will materially simplify the transportation of milk, as its weight is less than one-tenth the weight of the proportionate liquid milk. It will be very difficult to adulterate, for primarily no water *can* be added without the possibility of detection, and in the second place, no chemicals *need* be added to preserve unchanged its qualities as a raw milk indefinitely.

The extent to which British shipowners dispose of old vessels to foreigners is shown in statistical tables published in Lloyd's Register of Shipping. The tonnage cleared off in this way last year was 512,701 tons, comprising steamships of 422,395 tons, and sailing vessels amounting to 90,306 tons. By these sales, which are the largest since 1900, Germany acquired 101,903 tons, Italy 78,671 tons, Japan 66,328 tons, and Norway 59,702 tons. It must be a very considerable advantage to have a market like this for "second-hand" vessels. Tables which are included in the registrar-general's returns indicate that about 18 per cent of the tonnage removed from the Register because of foreign transfer was built before 1880, nearly 43 per cent before 1885, 62 per cent before 1890, 78 per cent before 1895, and over 90.6 per cent before 1900. In addition to the second-hand tonnage transferred to foreigners, 52,464 tons were transferred to British colonies during 1905, compared with 37,464 tons in 1904, 62,907 tons in 1903, and 32,603 tons in 1902.



The Clarifier for Removing Impurities.



The Evaporator with Vacuum Pump.

DRIED MILK—A NEW PROCESS.

THE MAGIC SPHERE—AN ILLUSION APPARATUS IN WHICH CURIOUS OPTICAL EFFECTS ARE PRODUCED BY CENTRIFUGAL FORCE.

BY DR. ALFRED GRADENWITZ.

The paradox that we actually see things right-side up, although our eyes are constructed to see them upside down, has never been satisfactorily explained. Anatomical reasons are sometimes given. It is suggested that the optic nerves, which transmit the visual impression to the brain, cross each other, and that the inverted image of the retina will therefore be seen vertically. It seems that in all these explanations the theorist confuses the *subjective* visual impression and the merely *objective* optical phenomenon, viz., the production of an image on the retina.

Fig. 1.—Incline your head to the right at an angle of 45 degrees and stare at the filament of an incandescent lamp. The filament will appear vertical as in the top figure. Shut your eyes, hold your head in its normal vertical position and then open your eyes. The filament will for a moment appear inclined as in the second figure. Incline your head 45 degrees to the left, stare at the filament, close your eyes, and bring your head back to its normal vertical position. Two images of the filament will be seen crossing each other at right angles.

That upright vision is quite independent of the position of the image on the retina, may be inferred from the fact than on inclining the head, we still see objects in their proper positions, although the positions of the images on the retina are changed. The question naturally arises: By what standard, conscious or unconscious, does the eye judge in gaging the upright position of things independently of the position of the head? Is there perhaps some organ which acts like a carpenter's plumb-line or spirit-level and indicates the direction of a given line?

Sir Hiram Maxim has given some thought to this problem. His views were seriously influenced by a chance observation. One day, when he was tired from a long railway journey, he noticed, on looking at an incandescent lamp, and then closing his eyes, that a distinct image of the filament still remained, which is a well-known optical phenomenon. After turning his head to the right about 45 deg. still looking steadily at the lamp for about half a minute, he closed his eyes and placed his head in a vertical position. He then found that the image of the filament was inclined 45 deg. in the other direction. He now turned his head to the left, and again looked steadily at the lamp. On closing his eyes and placing his head in a vertical position, he distinctly saw two images of the filament crossing each other at about 90 deg. (Fig. 1.) This proved to his mind that the position of the head and the angle of the image on the retina had nothing whatever to do with seeing things right-side up. Not only this, but it showed at the same time that we judge the position of objects on the retina by comparing them with some organ which is a part of the mechanism of seeing, and which is controlled by the attraction of gravitation, as are the instruments used by the carpenter and builder above referred to.

The next experiment was to ascertain if this organ could be influenced by any force other than gravitation. If we place a spirit-level on the edge of a slowly revolving table, the liquid is thrown outward and the air bubble inward; if we hang a plumb-line to a rotating arm, it will be thrown outward by centrifugal force to an extent governed by the speed of rotation. The line will never be vertical except when the arm is stationary. Are the organs of sight similarly influenced by centrifugal force? Actual experiments have demonstrated that they are. It was found that if a person were placed in a receptacle, which was caused to travel in a large circle until the centrifugal force was just equal to the force of gravity, objects really vertical appeared to be tilted to one side, thus establishing a new standard line which the organs of sight use for comparing all objects seen. (Fig. 2.)

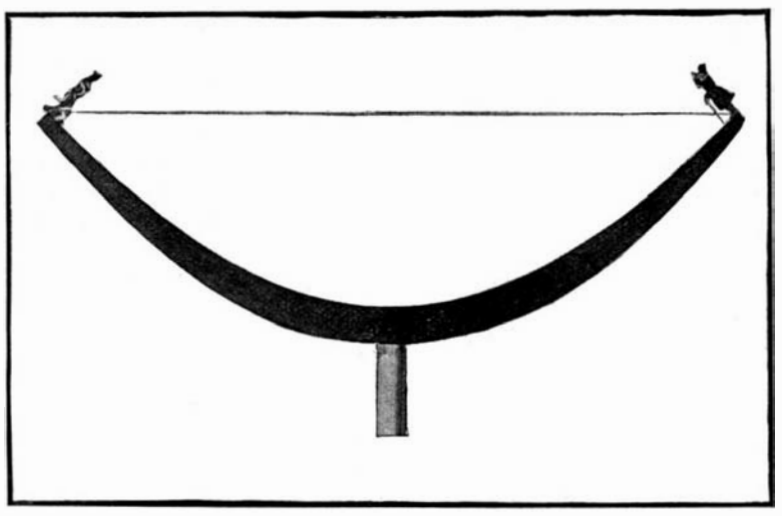


Fig. 3.—Section of a parabolic floor. To the woman the only level part of the floor is apparently the spot on which she is standing. To her the man on the other side appears to be projecting horizontally from a vertical surface. The man cherishes the same illusion about the woman.

Suppose that we have a large circular room, 30 feet in diameter; suppose that we spin this room on a vertical axis fourteen times each minute. If a man should stand at the extreme outer edge of the room, he would be pulled outward with a force exactly equal to the force of gravity. If the floor on which he stands is dead level, it will appear to him to be tilted upward 45 deg. and that he is standing on the lowest edge; if he stands on a platform which is really tilted 45 deg. above the horizontal, it will appear to him dead level, while the rest of the floor, which in reality is level, will be tilted upward. Under these conditions the pressure of his feet against the platform will be increased 40 per cent.

It is evident under these conditions that it is only at the extreme edge of the floor that the maximum effect is produced. Centrifugal force diminishes as one moves toward the center.

Fig. 3 shows the approximate shape of the floor that must be used in order that the centrifugal force and gravity may balance each other, no matter on what part of the floor one stands. Its shape is a parabola. If two people stand on opposite sides of this parabolic floor, it will appear to each that the floor immediately under his feet is dead level and all the rest of the floor tilted upward, while the person standing on the opposite side appears to be walking on a vertical surface. Fig. 4 shows the exact shape of a parabolic floor 30 feet in diameter and making fourteen turns a minute. It will be observed that the extreme outer edge is 45 deg. above the horizontal.

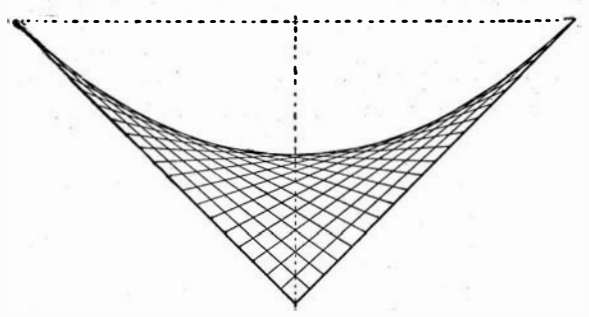


Fig. 4.—In order that every part of the rotating floor should appear dead level to those standing on it, it must be so curved that the centrifugal force and the force of gravity will exactly balance each other. This drawing shows the exact shape of the floor and the manner of describing the correct parabolic curve.

If a person is placed on a rotating platform inside of a stationary room, he will become dizzy; and conversely, if a man is placed on a stationary platform and the room revolved about him, he will become dizzy in exactly the same degree. Look in a revolving mirror, and you will become dizzy. Hence, our rotating parabolic floor must be mounted in a room that rotates with it. No dizziness will then result. The most convenient way to do this is to place the rotating parabolic floor inside of a large rotating sphere, which may be entered through the center at the bottom. In order to give the sphere an attractive appearance, the outside is mapped off and painted like a large terrestrial globe.

Our front-page illustration shows a vertical central section of the sphere with the pedestal on which it is mounted and the driving gear. The entrance and the stairways may be either covered over or provided with a rail, which is not shown in the drawing.

Some very curious and interesting phenomena will be manifest with this apparatus. While in rotation, the floor immediately under your feet will always appear level. Walk from one side to the other, and the whole apparatus will seem to tilt over exactly as if it were floating in water, and as if you were infinitely heavy and everyone else infinitely light. You can walk with perfect freedom in a circumferential direction, but if you walk quickly in a diametrical direction, you will be apparently pushed to one side. You will find it most difficult to walk in a straight line except very slowly. A cyclist riding in the direction of revolution adds his own centrifugal force to that of the apparatus. He is able, therefore, to ride off this parabolic floor and upon the inner walls of the sphere. To those standing on the extreme edge of the parabolic floor, he is seen riding up the walls of the room across the ceiling and down on the other side. If mirrors are placed above the floor, the whole interior of the sphere seems filled with people, feet pointing outward and heads inward. It is believed that this system is well adapted for a skating-rink. Mounted on roller skates, you could perform some most extraordinary feats with very little effort. It is said that no roller skates can ever be made in which the coefficient of friction is so small as it is with the ice skate; but with this system, by increasing and diminishing the speed periodically, say four times a minute, the friction would disappear altogether, the motive power doing all the work and the skater nothing. In a skating-rink the floor would of course be larger and flatter, and the rotation much slower.

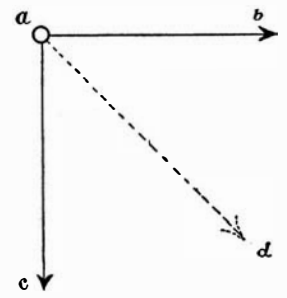


Fig. 2.—Suppose a man weighing 100 pounds, standing at the point *a*. Gravitation will pull him toward *c* with a force of 100 pounds. Suppose that this man is also subjected to a centrifugal force of 100 pounds which tends to pull him toward *b*. He will as a result move in the direction *a d* with a force of about 141 pounds. To him the dotted line will appear vertical.

[Interesting as the principle upon which the Magic Sphere is conceived undoubtedly is, we may be permitted to disagree with portions of the author's explanation. Above all, we question the existence of any gravitational sense-organ. A man placed at the outer edge of a rotating table and subjected to a centrifugal force which just balances the force of gravitation would, in moving toward the center of the table, incline his body forward, so that the force of gravity would be permitted to gain the ascendency. He does this in response to the mechanical requirements of his position. In that inclined position he would not experience much difficulty in walking despite the author's contention. Furthermore, objects would appear tilted because he is himself tilted, because he refers the position of other objects to himself, and not because of any hypothetical gravitational sense. We believe that the author has failed to take cognizance of this involuntary inclination of the body when subjected to the action of centrifugal force in explaining the paradoxes of the Magic Sphere. Similar phenomena are observed on ordinary railway trains traveling on curves at high speed, when the outer rail is appreciably elevated above the inner rail. Because we assume that the car is vertical, houses, trees, and telegraph posts seem askew as we whirl around the curve. We form part of the train, we refer the external objects to ourselves, and hence we see them inclined. We are always subject to the action of gravitation and we always compare external objects with the vertical line that passes from our heads through our bodies.—ED.]

An invention which will be of inestimable value to the blind has been effected by Mr. W. G. McLaren, of Edinburgh, whereby the ordinary, laborious, and expensive process of punching the Braille letters is superseded. He has also perfected a process of printing the embossed Braille letters on aluminium sheets instead of paper. The sheets are far easier to read than the best paper books, especially by those who have become blind late in life, or whose fingers are not very sensitive. They are also practically indestructible. The thickness of the sheets is 0.004 inch, and a book of twenty royal quarto pages can be produced for $1.25 per copy. By means of the McLaren printing process, a ten-page paper in Braille type can be sold for two cents per copy. Hitherto the production of books and papers for the blind has been so prohibitive as to be beyond the reach of all except the privileged few.

Fig. 5.—This picture shows how the rotating parabolic floor will appear to an observer standing on its outer edge. The cyclists are apparently riding on a vertical surface.

THE HOT-AIR BOILER.

The development of the automobile and the ever-increasing demand for small motors of high power and light weight have established conditions which are fairly well met by the gasoline engine—far more satisfactorily indeed than by the steam engine or the electric system; and yet a gasoline engine even of the best possible construction is, in regard to flexibility of power and ease of control, by no means the equal of either of its rivals. A gasoline engine generates power very economically and is of light weight and convenient proportions; but it usually requires a variable speed reversible transmission, to render its power available for the purpose of an automobile; and in addition to this it must be cranked by hand to start it. It also requires a considerable amount of dead and otherwise useless weight in the form of a flywheel. in order to convert its sudden explosive impulses into continuous rotary motion.

The steam engine, on the other hand, is instantly reversible, and may be stopped and started and controlled with the greatest ease; but the inevitable steam boiler, with its roaring fire and an insatiable greed for fuel, forms a most unwelcome accompaniment. There is, however, an improvement upon the steam boiler. This is a pressure-generating device which, for the sake of brevity and convenience, we may term the hot-air boiler, otherwise known as the thermic or thermodynamic generator, or continuous-combustion generator, etc. This device, as originally conceived, consists simply of a steam boiler without a stack, and with a firebox or combustion chamber inclosed within the shell, the products of combustion being discharged directly through the water into the steam space of the boiler. A blast of air and gaseous fuel is continuously forced into the firebox, under a pressure which must of course be a little higher than that of the boiler. The products of combustion come into actual contact with the water, mingling with and superheating the steam, and adding their volume to the working fluid of the generator.

The writer once tried an interesting experiment along this line, which any one may repeat with the apparatus shown in Fig. 1, in which *A* is the combustion chamber or firebox, consisting of a piece of 2½-inch iron pipe, 8 inches long, one end of which is open, and the other capped and reduced to receive a piece of ¾-inch pipe, *B*, about 3 feet long. This is the mixer, gas and air being led into it by the arrangement shown at the top. The air enters at *C* under a few pounds pressure, and the gas is admitted at *D*. The firebox, *A*, is lined with asbestos, secured by means of water glass used as a cement. The purpose of this lining is to fire the gas, and burn it completely within the walls of the firebox. After being lighted and properly adjusted, this device was plunged vertically with the open end down into a barrel of water. The effect was an amusing spectacle, a veritable conflict of fire and water. The gas mixture, kept alight by the asbestos lining, continued to burn within the firebox, and issued forth fiercely into the water in spite of the efforts of the latter to extinguish the flame. In a surprisingly short time the water was boiling hot and in a state of violent ebullition, the disengaged steam being doubled in volume by the burnt air and gas which mingled with it.

No accurate test of the arrangement was made to determine the amount of gas necessary to effect a given evaporation, but it is evident that the thermal efficiency must be very high. The fire-box being of sufficient size, the combustion of the fuel is completed within it, and the hot products impart their heat to the water by direct contact as they rise in a torrent of expanding bubbles to the surface.

The basic idea upon which these generators are built is by no means new. Propositions for the construction and use of such generators, usually for stationary power plants, have formed the subject of a number of patents, and have occasionally appeared in the columns of the technical press; but notwithstanding this, the idea would seem to be little known, and so far as the writer is aware, the method has not yet been practically applied to either road or marine locomotion. This is probably on account of difficulties which arise from defects in the compressed-air and fuel-regulating devices. It seems evident, however, that the system is capable of successful development, and promises advantages of such a nature as to merit further consideration.

The intention of the first experimenters with this system of power generation was evidently to construct a boiler in which steam would form the principal part of the working fluid, the stream being superheated and considerably increased in volume by the burnt air and fuel gases which mingle with it. The more modern idea, however, is to so construct the generator that the working agent will consist principally of the highly-heated products of combustion mixed unavoidably with a little steam; the water being used only to cool the gases slightly, and to moderate the otherwise excessive temperature of the generator and engine.

Fig. 2 shows the principle upon which these thermic pressure generators are constructed, in which *A* is the boiler shell, *B* the combustion chamber, and *C* the inlet pipe for the gas and air, the water being carried in the space surrounding the combustion chamber, as shown. The air and vaporized fuel or gas is forced in through the inlet pipe, *C*, under a pressure slightly above that of the boiler. The combustion chamber should be lined partly at least with asbestos, to keep the flame alight. It might also be furnished with an electric sparker for starting. The amount of steam produced by this device would depend upon the size of the combustion chamber and the surface exposed to evaporation. It is desirable, however, to so proportion the arrangement that the steam will constitute from one-fourth to one-third of the total volume of the working fluid. This would probably moderate the temperature of the generator to such an extent that an ordinary double-acting steam engine could be employed. The economy of performance would of course not be quite equal to that of an internal combustion engine, but it would be far superior to that of an ordinary steam boiler. In fact, the fuel cost of driving an automobile by this system should not exceed one cent a mile, per thousand pounds weight, with gasoline or other liquid fuel at 15 cents a gallon; and the quantity of water to be carried would not exceed one-third of that necessary with a steam boiler and engine of equal power. Another welcome advantage would be the small size and light weight of the generator. For a 6-horse-power automobile system, the diameter of the

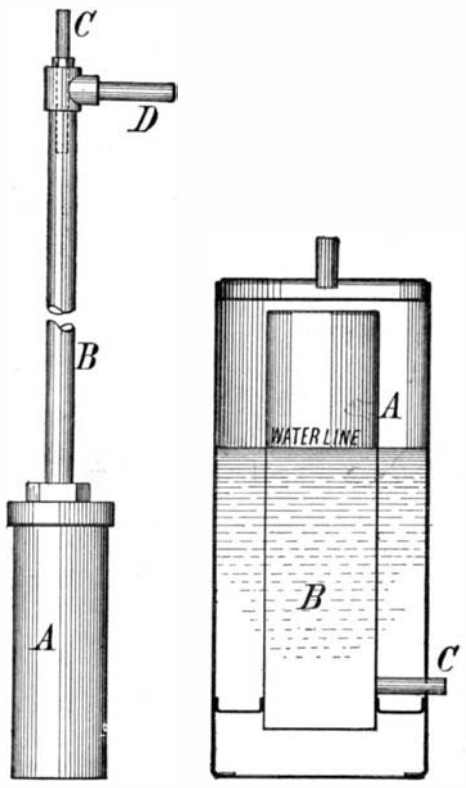


Fig. 1. Fig. 2.

A HOT-AIR BOILER.

outer shell *A*, in Fig. 2, need not exceed 8 inches, with a height of 16 inches. The combustion chamber might be about 3 inches in diameter and 12 inches high. The air required would be about 25 cubic feet per minute at atmospheric pressure; and to compress this air to 250 pounds per square inch would consume something like one-sixth the power developed by the engine; if this was originally 6 horse-power, we would have left 5 horse-power available for work.

There would be no visible fire, or danger from fire, in a power system of this kind, and no flywheel and no transmission. In fact, the convenience and flexibility of the steam engine would be combined, to a considerable extent at least, with the thermal economy of the gas engine. The system might also be recommended as a very useful factor in the solution of that vexed problem, the gas turbine.

The Current Supplement.

The services rendered to mankind by the canal engineer have, perhaps, been undervalued. The opening article of the current Supplement, No. 1589, dealing with canals, ancient and modern, seeks to remove this impression and establish him in favor by reviewing his ancient and modern work. The devotion of Herbert Spencer to the study of philosophy has somewhat obscured the fact that his early life was that of a professional surveyor and engineer. In a brief biography his engineering career is instructively discussed. Statistics are given of the passengers carried by the large Atlantic liners. Mr. J. E. Thornycroft writes authoritatively on gas engines for ship propulsion. Artificial fuel forms the subject of a well-considered article. The English correspondent of the Scientific American writes on some interesting applications of the gasoline motor. R. A. Hadfield presents some unsolved problems in matallurgy. The influence which the discovery and the use of metals have had in uplifting man from his early low estate is discussed by Nelson P. Hulst. Still another metallurgical article is that on the annealing of metals by W. J. May. To secure the greatest efficiency in a battery, the elements must be arranged so as to adapt the electro-motive force and the internal resistance to the resistance of the external circuit. How this may be best accomplished is told in an article by George M. Hopkins on the arrangement of battery cells. Major Ormond M. Lissak writes on primers and fuses for cannon.

Automobile Notes.

The next test to attract the attention of automobilists in America is the second annual economy test of the New York Motor Club. This test will be conducted on the ton-mile basis, the total cost of operating a car per ton-mile being compared with the railroad fare. The test will occupy three days—June 20, 21, 22—and will be run from New York to Albany, Springfield, and New York. The total distance is 430 miles. Accurate records will be made of fuel and oil consumption and repairs of all kinds.

Out of the forty-eight contestants who started in the 2,444-mile Coupe d'Or endurance test in Italy on May 10, but sixteen succeeded in finishing on May 24. The test ended at Milan, the last day's run being but 98 miles. The first cars to finish were a San Giorgio-Napier driven by McDonald, an Itala driven by Cagno, and a Fiat driven by Lancia. The winner of the test will be announced later. The test was an exceedingly strenuous one, and only one-third of the starters finished. This was a much poorer showing than has been made in any of the several endurance tests that have been held in this country.

Upon the arrival of the 16-horse-power Reo "Mountaineer" touring car in New York on June 10, the first "round trip" across the continent in an automobile was completed. Percy F. Megargal and David F. Fassett have driven this car over 12,000 miles since last August, under all sorts of conditions and in all kinds of weather. That an automobile can survive such a test, during the course of which its drivers several times nearly lost their lives, is the best proof of the soundness of construction of the American car.

The first big touring event of the year—the contest for the Herkomer trophy—was started in Germany on June 6. The first day's run from Frankfort to Munich was marred by the overturning of a car on a sharp turn and the serious injury of its occupants. The test was for touring cars carrying four persons. It consisted of six daily runs of from 200 to 250 miles each, and also of a series of hill-climbing and brake tests. The only American entrant was Percy Pierce, of Buffalo, who drove an "Arrow" touring car of his own make, similar to the one with which he won the Glidden trophy in this country last summer. The most notable entrant in the tour was Prince Henry of Prussia, the brother of the German Emperor.

The course and rules of the Glidden tour have at last been determined. The contestants for the trophy will start from Buffalo on July 12 and travel eastward to Saratoga, thence north to Montreal and Quebec, and then south again to the Rangeley Lakes in Maine and the White Mountains in New Hampshire. The total distance of the tour is 1,443 miles. The cars will be obliged to keep to a schedule, a pacemaker being provided, and points will be deducted for falling behind or on account of stops for repairs. No repairs or adjustments will be allowed in the garages, and the time for these and for filling the oil and fuel tanks will be counted in the running time. This event is open to touring cars carrying four people of an average weight each of 125 pounds. Non-contestants for the Glidden trophy may enter the tour and not be obliged to obey all the rules under which it is conducted, unless they so desire. The following additional trophies will be given: One trophy, offered by Paul H. Deming to the entrant, not a contestant for the Glidden trophy, who has the lowest penalization under the rules; repairs, replenishments, replacements and inspection in garage being permitted. This trophy is to be competed for between Buffalo and Bretton Woods. One trophy to the club from whose membership the largest number of entries are received in proportion to the total active membership of the club. One trophy to the winner of a hill-climbing contest. One trophy to the winner of a brake test. One trophy to the winner of an obstacle race. One trophy to the car having the least tire trouble during the contest. One trophy to the car which shall complete the tour from Buffalo to the end of the tour under the most adverse conditions and with the greatest number of tire and mechanical troubles.

A writer in the American Machinist stated recently that a steam pipe of 6 inches to 8 inches diameter was covered with a wooden box of 12 inches diameter which was filled with a sawdust mortar, one barrel of lime to five of sawdust. Before covering the pipe—nearly 700 feet in length—it condensed 1,440 pounds of water hourly; after covering it condensed 195 pounds hourly.

Correspondence.

Wooden Buildings of San Francisco.

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to say a few words in correction of a misapprehension as to our buildings which seems to prevail on your side of the continent. In speaking of the fire in San Francisco in your issue of May 12 (delayed in transmission), you several times allude to the "intense heat" of burning redwood. As a matter of fact, we do not build our dwellings or other wooden buildings of redwood, but of what is known in the trade and commonly called Oregon pine, though it is not pine, and most of it comes from Washington. It is the Douglas spruce with some yellow fir, which is universally used on this coast for construction purposes. In an ordinary dwelling the frame, joists, floors, furring, lath, etc., is all spruce or fir, only the weather boarding and shingles are redwood for the reason that they stand the weather better and are much less inflammable. As for the "intense" heat that came from the burning redwood, it is about the poorest firewood we have. A large building of wood like the Pleasanton or Bella Vista hotel, with a diagonal pine sheathing under the weather boarding, is about eighty per cent pine, arranged in the most favorable manner to produce an intense heat, and I have often commented on the risk of such construction. Redwood is too expensive and does not possess the strength necessary for buildings, while the spruce we use is as strong as eastern oak and much cheaper than redwood.

HENRY S. DURDEN.

San Francisco, Cal., May 22, 1906.

A Perpetual Calendar.

To the Editor of the SCIENTIFIC AMERICAN:

Some notes and queries in recent issues, discussing the above topic, with the object of rendering us independent of the almanac makers, tempt me to describe a mental date finder of my own, employed by me for many a year past.

The calendar is based on a fact that gave me some little pleasure at the time of its discovery, namely, that Independence Day, as well as the 4th of the 4th month in any year, the 6th of the 6th, the 8th of the 8th, the 10th of the 10th, and the 12th of the 12th month, always fall on the same day of the week.

In 1906 this starting point happens to occur on a Wednesday. Consequently, should the difference between any date in April, June, August, October, or December, 1906, and its month be 0 or a multiple of 7, that date must necessarily be a Wednesday also. For other months a slight correction is requisite, but the adjustment numbers, where such are needed, can easily be memorized from the following simple table:

Months.		Correction for ordinary years.		For leap years.	
1	2	2	5	3	6
3	4	4	0	4	0
5	6	4	0	4	0
7	8	4	0	4	0
9	10	3	0	3	0
11	12	3	0	3	0

The interpretation of which is that in May, June, and July, for instance, 4, 0, and 4 respectively must be added to the month before subtracting from the given day of that month. A remainder, then, of 5 would mean that the date in question, assuming we are still dealing with the year 1906, falls on a Monday (i. e., five days after Wednesday). Similarly a —5 resultant would represent a Friday.

The process of ascertaining the relation of a date in one year to the corresponding date in another has already been explained in your columns. It involves the addition of intervening leap years to the difference between the years under consideration.

To express these conclusions algebraically:

Let d = the day of the month.
m = the number of the month.
c = the correction figure for the month m.
D = the day of the week relatively to that of Independence Day of the year y.
$I\,y$ = the day of the week on which Independence Day falls in the year y^1.
l = the number of leap years between y and $y \pm p$.
p, q, r = any integral numbers.

Then

(1) $d = \overline{D - I\,y} + m + c \pm 7\,q$
gives the days of the month in any year on which a named week day falls.

(2) $a.\ I\,\overline{y + p} = I\,y + p + l \pm 7\,q.$
and

(2) $b.\ I\,\overline{y - p} = I\,y - p - l \pm 7\,q.$
Supply the relation of the radical or Independence Day of the year y to other years.

(3) $d/m/y = I\,y + d - \overline{m + c} \pm 7\,q$
gives the day of the week, relatively to the day on which Independence Day falls in the year y.

Or generally:

(4) $d/m/yr = I\,y + d - \overline{m + c} \pm (yr \sim y + l) \pm 7\,q$, using the positive sign of $(yr \sim y + l)$ when yr is a year subsequent to y and the negative sign for anterior years.

A few examples may be given by way of illustration, starting from I_{1906} = Wednesday:

1. Which dates in May, 1906, are Fridays?
In formula (1) $D - I_{1906} = 2$; $m = 5$; $c = 4$;
$\therefore d = 2 + 5 + 4 \pm 7\,q$
= the 4th, 11th, 18th, and 25th, May, 1906.

2. Give the days of the week for Independence Day, 1951 and 1776.
From formula (2a) I. D. 1951 = Wed + 45 + 11 — 56 = Wednesday;
and from formula (2b) I. D. 1776 = Wed — 130 — 30 + 161 = Wed + 1 = Thursday.

3. 1.12.06 from (3) = Wed + 1 — $\overline{12 + 0}$ + 14 = Wed + 3 = Saturday.

4. 30.9.1910 from (4) = Wed + 30 — $\overline{9 + 3}$ + $\overline{4 + 1}$ — 21 = Wed + 2 = Friday.

5. 24.1.07 from (4) = Wed + 24 — $\overline{1 + 2}$ — $\overline{39 + 9}$ + 28 = Wed + 1 = Thursday.

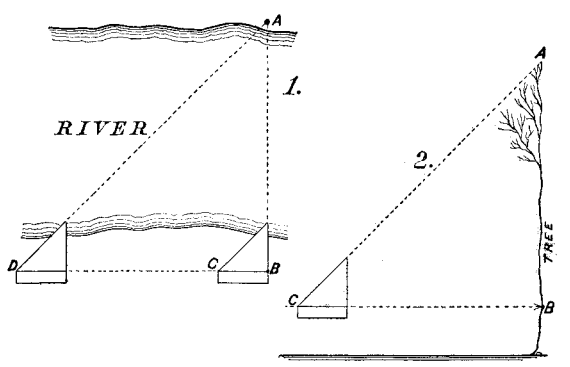
I venture to think that these methods are simpler, for the purposes of mental calculation, than the others which have hitherto been discussed.

A. H. C. HAMILTON,
Allahabad, India. Barrister at Law.

Simple Surveying.

To the Editor of the SCIENTIFIC AMERICAN:

I beg to submit to you another simple method for measuring the distance across a river or between two points. For the first purpose, select an object on the opposite bank of the river, as at A in the accompanying drawing, Fig. 1, and at B, on the side of the river at which the observer is stationed, place a page of the SCIENTIFIC AMERICAN folded, as shown, into a right-angled triangle with the right angle at the point B and one side coinciding with the line from B to A. A leaf of a note book or other sheet of paper is, of course, also available, and the folded sheet forms a right-



angled triangle having acute angles each of 45 deg. The observer now moves along the bank of the river with the paper triangle in the direction of a line formed by an extension of the side $B\ C$ until a point, D, is reached where one side of the triangle coincides with the line from B to D and the hypotenuse coincides with the line from D to A. $D\ B$ will then be the equal of the distance from B to A. To ascertain when the observer has arrived at D it is necessary to sight along the hypotenuse of the triangle toward A and along the side of the triangle coinciding with the line, $D\ B$, to insure that the latter side still coincides with the line from B to D.

To measure the height, for instance, of a tree, the observer first marks the height of his eyes upon the trunk at B, Fig. 2, and then walks away to a point, C, carrying the paper triangle with him, where the lower side of the triangle coincides with the line from C to B, while the hypotenuse coincides with the line from C to A, the top of the tree. The observer sights along the hypotenuse and a side of the triangle as in the first case. The distance from C to B plus the height of the observer's eyes above the ground is the height of the tree.

W. F. DAVIS.

Osborne House, Victoria, B. C.

Fireproof Building Construction.

To the Editor of the SCIENTIFIC AMERICAN:

Will you allow me the courtesy of your columns to reply to the letter (published June 2) of your correspondent, A. Mayn, who seems to be under the impression that a steel and iron structure would be fireproof?

I should like to emphasize the fact that unprotected steel is not fireproof, although it would seem that this should now be generally known. In the handbook "Fire-Resisting Design," published by the Home Insurance Company, the writer says: "The vital point in fireproofing is unquestionably the proper protection of the structural members against the combined action of fire and water. A building in which the iron and steel work, although heavy, is improperly or entirely unprotected, may prove relatively weaker than a much lighter form of construction in which proper regard has been shown this feature." Also in the Building Code of the National Board of Fire Underwriters it is recommended that "iron or steel columns be protected with not less than four inches of hard-burned brickwork, terra cotta or concrete." The building code of the city of Cleveland, Ohio, says: "Coverings for columns shall be of not less than eight inches of brick or four inches of semi-porous terra cotta."

It is obvious, therefore, that there is a consensus of opinion as to the need for protecting all the structural steel of a building. In the Baltimore fire steel columns, protected by terra cotta, suffered but one or two per cent damage, while unprotected columns buckled and collapsed, bringing down floors and partitions. The report of the committee of the National Fire Protection Association on this conflagration says: "Structural metal work must all be properly protected so as to withstand successfully the effects of severe heat."

Mr. Mayn's question, "Why not use steel and iron only?" is answered by the above. Such a structure as he suggests would be earthquake proof, but would have no chance of surviving the intense heat generated in a great conflagration. In fact, the tendency is now to do away with steel or metal as far as possible. This has recently been shown in the construction of the new Custom House in New York city. The huge dome in the center of the building is built entirely of hollow tile, with hollow tile supporting ribs instead of steel. Not only is the dome self-supporting, but it also carries the 140-ton metal and glass skylight top. The stairways are also built of hollow tile in the form of Guastavino arches with no metal or other support. Similar forms of construction are to be seen in the domic ceilings of the Gorham and Tiffany buildings of this city. The absence of steel and iron in these domes, ceilings, and stairways makes them the most fireproof of any form of modern construction.

New York, June 1, 1906. IVY L. LEE.

Water Tanks on Buildings Shaken by Earthquakes

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of April 28 you have an article on earthquake-proof construction, in which you say: "Moreover, the ability of the fire department to cope with such local outbreaks would be greatly assisted by an elaborate provision of an independent fire-service tank, of extra large capacity, at the top of every building."

In relation thereto the following inquiry arises: When a sky-scraping structure is rocking like a cradle, with an occasional short jerk like a boat in a chopped sea, what is going to become of your extra large tank of water on top of the building, where people are being hurled bodily out of their beds and are stopped by the hard wall of the opposite side of the room, tossed hither and thither like a helpless babe? I imagine that the water in the extra large tank on the top of the rocking building would slop over; or the whole affair, weighing many tons, might come down, carrying everything before it to the basement. You might correspond with Messrs. Woodward & Lathrop as to the large damage they suffered on account of a slight mishap to a water tank on their building. The accident occurred some years ago. I also saw an iron stair-case carry everything before it to the basement.

I think that heavy tanks, even under ordinary circumstances, when placed on buildings are a great risk; in a severe earthquake they would be fearful engines of death and destruction.

I believe that in tall buildings no cornice or trimming work should be allowed except light metal securely riveted to the structural frame of the building. For earthquakes are liable to occur anywhere on earth, and should be considered as a risk.

Seismographs indicate an almost continuous trembling or vibrating of the earth's crust.

I believe that steel tanks of extra large size should be placed in the basements of large buildings, or in the streets, so as to enable the firemen to operate even when the water mains cannot be made to furnish water.

I said steel tanks, advisedly, for there are instances where heavy blasts of dynamite have cracked cisterns miles from the place where the explosion occurred. So in order to guard against seismic disturbances, the underground cisterns should be built of steel imbedded in cement. Now, in case it is desired that water be thrown to the tops of buildings, another tank buried nearby (possibly underneath the water tank) could be so charged with compressed air or other gas (on the principle of automatic fire extinguishers) as to force the water to the desired elevation.

The compressed-air chamber would be thrown out of action if the connection between the tanks were destroyed, so that possibly the safest plan would be to construct the two as one tank with partitions.

Doubtless many millions of dollars' worth of property could have been saved in San Francisco had there been steel cisterns buried at frequent intervals, where the fire engines could have obtained water.

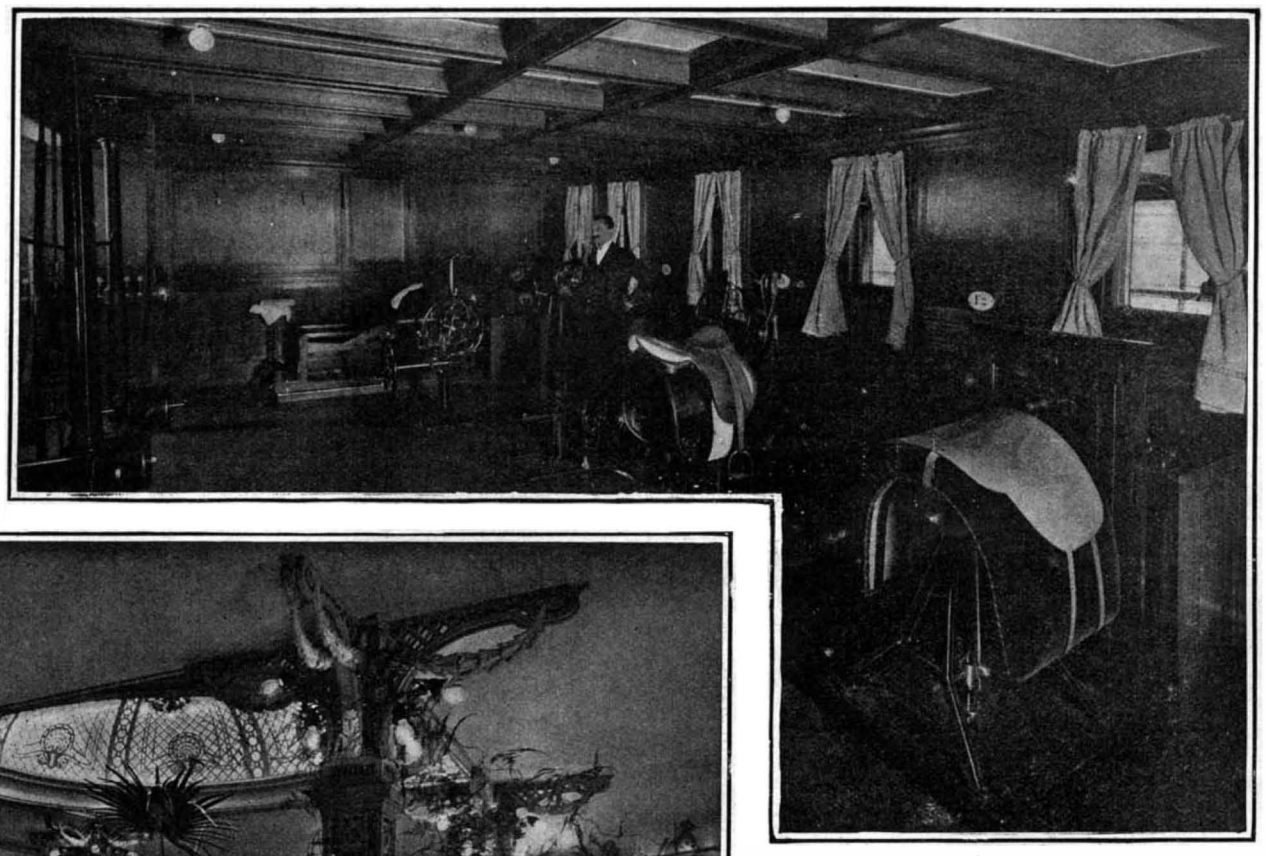
JOHN W. JONES.

Washington, D. C., May 4, 1906.

THE LATEST AND LARGEST STEAMSHIP.

In spite of the huge size to which the transatlantic steamer has grown, the dimensions of the latest of the new liners to visit this port exceeds them all. The "Kaiserin Auguste Victoria," of the Hamburg-American line, which has just completed her maiden voyage to New York, is to-day the largest vessel afloat. She belongs to that class of passenger ships of moderate speed in which the space that in a faster vessel would be given up to boilers and engines is reserved for cargo. Because of the higher revenue-earning ability thus secured, the passengers can be carried at lower rates than those which must be charged on such fast ships as the "Deutschland."

The "Kaiserin Auguste Victoria's" main dimensions are as follows: Length over all, 700 feet; beam, 77 feet; height from keel to boat deck, 87 feet; height from water line to boat deck, 55 feet. From the keel to the top of the masts is 187 feet; the smokestacks measure 13 by 16 feet in diameter, being oval in section. The ship has a cargo capacity of 16,000 tons, and a gross registered tonnage of 25,500 tons. It is estimated that when the engines have been running for a few months, she will maintain a sea speed of 17½ knots an hour. The coal bunkers have a capacity of about 3,500 tons.



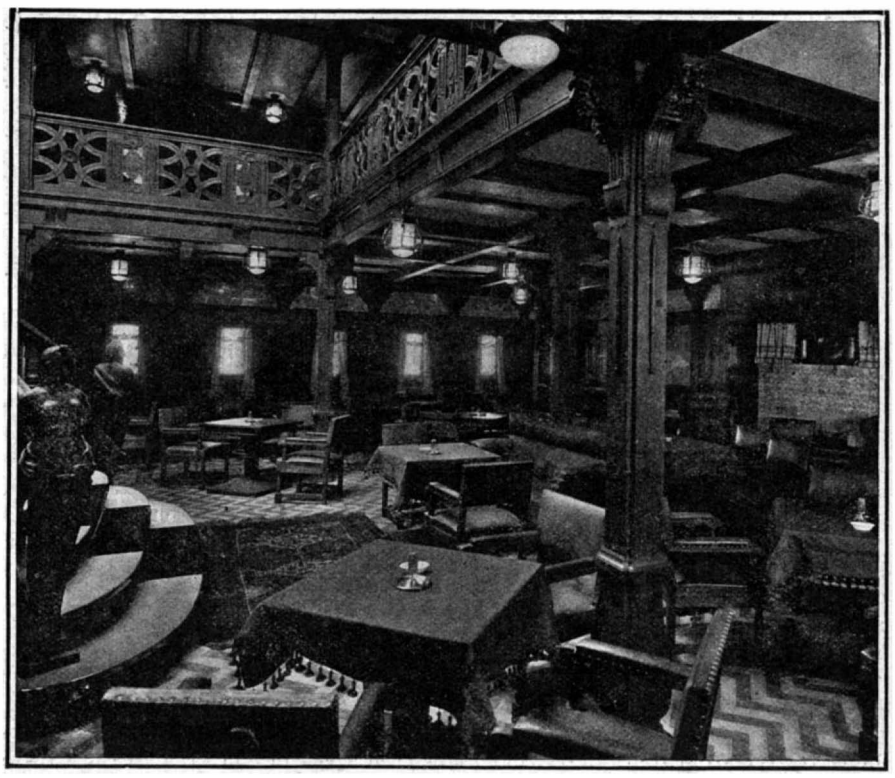
The Gymnasium.

View in the Palm Room.

The ship is driven by two four-bladed manganese-bronze screws, 22 feet in diameter. The propeller shafts are 19.3 inches in diameter, and 217 feet in length. The motive power consists of twin, quadruple-expansion four-cylinder engines of 17,200 horse-power. Steam is supplied by eight double-ended and one single-ended cylindrical boiler. Forced draft is used and the steam pressure is 220 pounds to the square inch.

The accommodations on the "Victoria" are planned on the same generous lines as those of the somewhat smaller sister ship "Amerika." A new feature, however, is the addition of one more deck, making no less than nine separate decks. The "Victoria" is therefore literally a marine skyscraper. Up to the main deck the vessel is divided by twelve transverse bulkheads. The compartments that lie below the main deck have each separate companionways, so that at night and during stormy weather the bulkhead doors can be kept closed. Above the main deck are four other decks, of which three can be used for promenading, the total area being 30,000 square feet. The promenades are from 12 to 15 feet broad and the height between decks is from 8 to 10 feet.

This huge ship is capable of accommodating, including steerage passengers, as many as 3,500 souls. In the first cabin there are 601 berths, in the second cabin 286, and in the third cabin 216 berths, making a total cabin accommodation of 1,103 passengers. The complement of the ship totals up 588 men, of whom 141 constitute the engine-room force, and 360 the kitchen and service personnel. The vessel has the usual luxurious suites of apartments, the decoration of which has been carried out with consummate taste, the colors being subdued and the furniture in simple and tasteful styles. There are the usual ladies' rooms, music room, library, and a magnificent two-storied smoking room, with a broad sweeping stairway connecting the two floors. The furnishing of this room is in oak in natural color, and it is richly adorned with paintings by well-known artists. In addition to the main dining saloon,



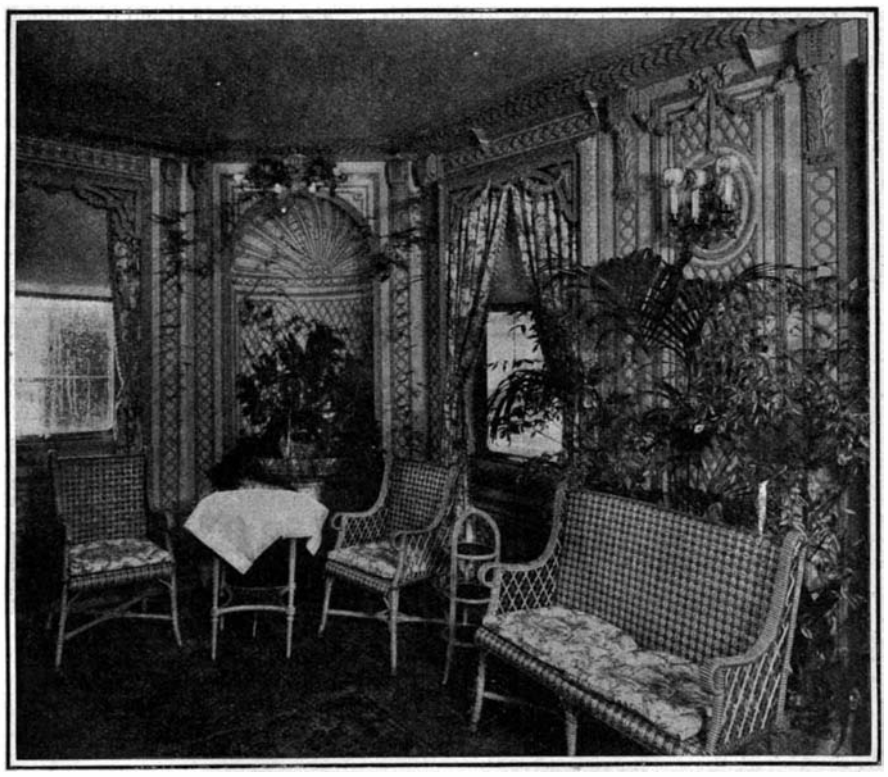
Upper Floor of the Smoking Room.

The Main Stairway.

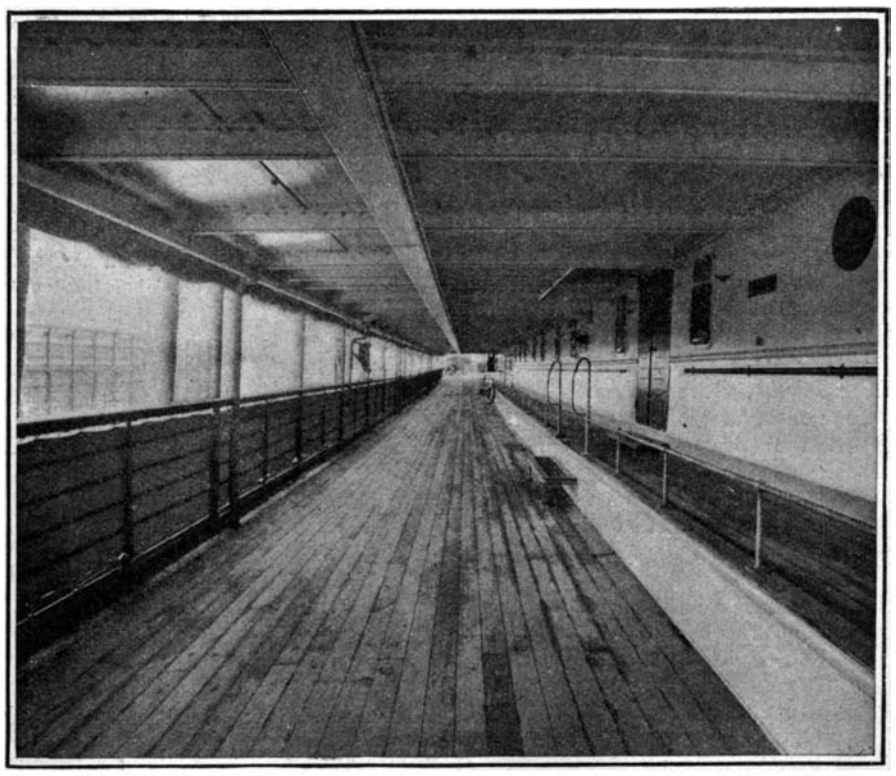
THE LATEST AND LARGEST STEAMSHIP.

there is a restaurant, where meals are served *a la carte* at any hour of the day. An excellent feature, which is characteristic also of many of the later German ships, is a gymnasium, which is stocked with apparatus on which one may reproduce the motions and general exercise of horseback riding, bicycling, etc.

As showing how completely the modern steamship has been brought up to the level of comfort of the first-class hotel, it may be mentioned that there is on board a florist's shop where fresh flowers can be procured at any time during the voyage, while at the after end of the Kaiser deck is another feature that is entirely new on transatlantic steamships, namely, a palm garden. As will be seen from our illustrations, this is a most dainty room, beautifully decorated with palms, plants, and flowers. The whole front is provided with windows of the size approximately, of those found in a city house; while the room is further lighted by a glass cupola in the center of the ceiling, which is carried on delicately carved pillars. The walls and skylight are beautified with a

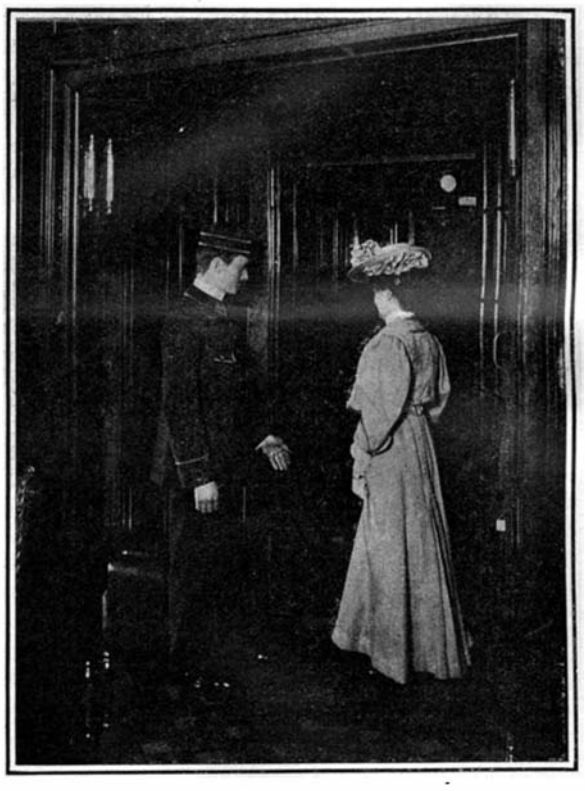


Corner of Palm Room, Showing Fountain and the Large Size of Windows.



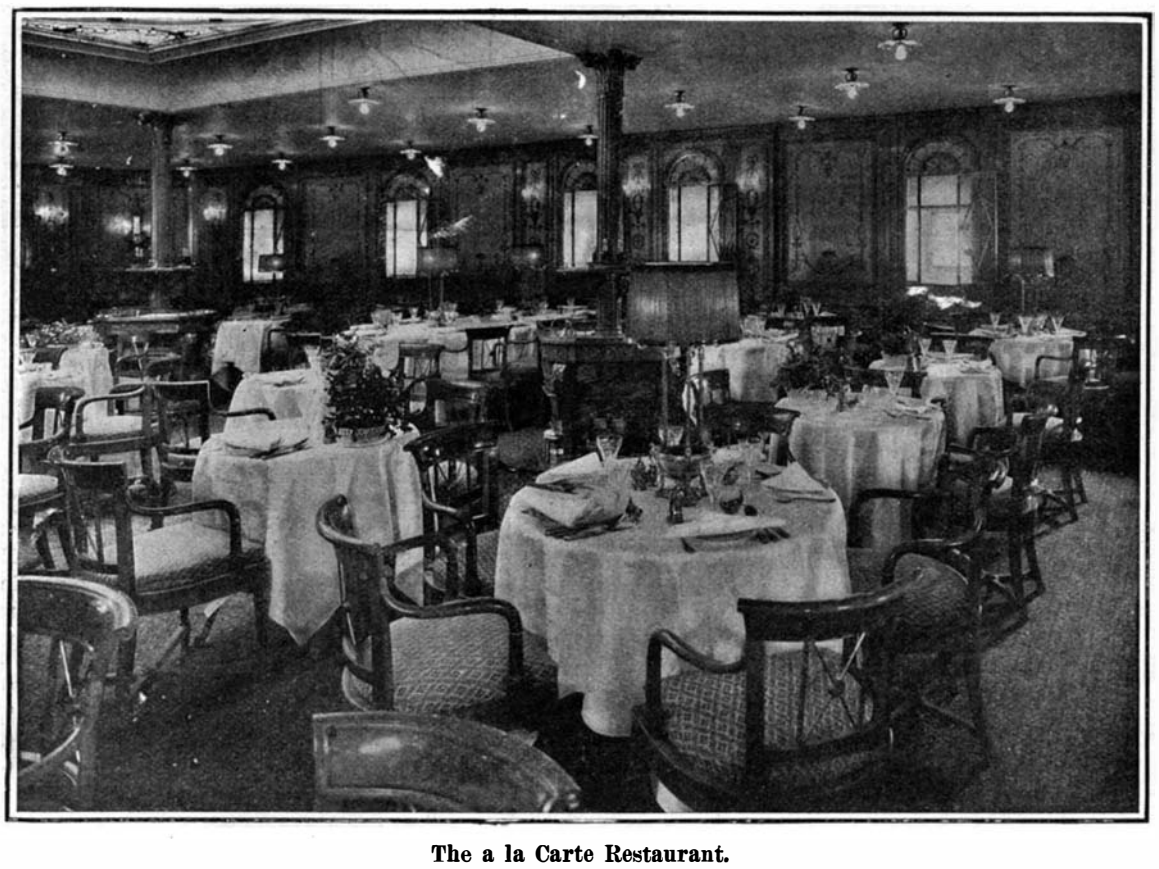
Novel Deck; Raised Promenade Section at Rear of Space for Steamer Chairs.

The Music Room.



An Entrance to the Elevator.

Stairway from Lower to Upper Floor of Smoking Room.



The a la Carte Restaurant.

THE LATEST AND LARGEST STEAMSHIP.

flower-covered trellis, while in opposite corners are two grottoes modeled after those of Versailles. When seated in this really dainty room, and listening to the splash of water in the fountains, it is difficult to realize that the scene is laid upon the deck of a ship, and not in some city hotel or private conservatory. Like her predecessor, the "Kaiserin Auguste Victoria" is provided with a passenger elevator, this being the second time that this modern invention has been installed on an ocean passenger steamer. A feature in the ship which will be highly appreciated is the great width of the passenger promenade decks, and the fact that on some of these decks there is a separate promenade, slightly elevated above the general level of the deck, along which passengers can walk without interfering with the view or inconveniencing those who are reclining in chairs.

EUROPEAN EARTHQUAKE RECORDERS.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

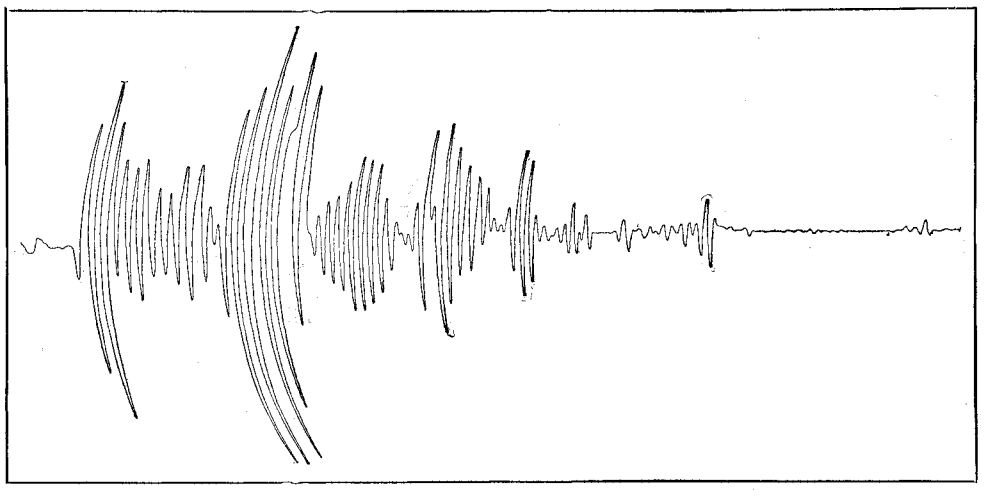
In order to show the present advances which have beeen made in recording earthquake disturbances in the different observatories of Europe, we illustrate some of the most recent work of Prof. Milne, the Director of the Shide Seismographic Observatory established in the Isle of Wight, also some of the instruments and researches of two of the leading Italian observatories.

Prof. Milne is at the head of an important project which is to systematize the records of earthquakes and so establish a base of scientific calculation and comparison of the results, by which it is hoped to find some general formulæ and conclusions of value in this regard. Owing to the great authority of Prof. Milne, the following information with which he has had the courtesy to supply the writer will be of interest. As it has been established that the movements resulting from a large earthquake originating in any one portion of the globe can with the aid of suitable instruments be recorded in any other portion of the same, the Seismological Committee of the British Association have asked for the co-operation of observers in various parts of the world so as to extend and systematize the observations of this nature. The first object in view is to determine the velocities with which this motion is propagated around, and possibly through the earth. To reach this result, all that is required at a given station is to have the times at which the phases of the motion are recorded. An instrument which takes the horizontal component of the movement is enough for this, at least to begin with. We may also secure other information in this way which will be of value. Thus we may be able to determine the force of submarine disturbances, such for instance as have interfered with telegraph cables, and thus new light will be thrown upon changes taking place in the ocean bed. The records also throw light upon certain classes of disturbances which are now and then noted in magnetometers and other instruments susceptible to slight movements. Local changes of level, some of which have a diurnal character, may also become apparent.

The committee have selected a type of instrument devised by Prof. Milne as being the best adapted for attaining the object in view, and at present a number of the leading observatories in different parts of the world have been equipped with this apparatus so as to co-operate in obtaining the results we mention. The instrument consists of an iron bed-plate and stand (as shown in the diagram) carried on three leveling screws. Resting against the needle-point or pivot projecting from the lower part of the stand, and held in a nearly horizontal position by a tie, is a light aluminium boom. Attached to the outer end of this boom there is a small rectangular plate in which there is a slit. The boom is properly pivoted and balanced, so as to form a horizontal pendulum. When the boom swings to the right or left, the plate with its slit passes to and fro across a fixed slit in the lid of the box, inside which a 2-inch strip of bromide paper is driven by clockwork. Light from a lamp is reflected downward by a mirror to cover the whole of the latter slit, but it only enters the box to the right and left of the moving plate and through the slit in the same. When the boom is steady, the result upon developing the band of bromide paper will be a white band equal in width to that of the moving plate, down the center of which is a clearly-defined line. To the right and left of the white band the paper is blackened by the light. The time intervals are shown on the bromide paper band by means of a watch movement whose minute hand, broadened out for the purpose, moves over the paper for about one minute and cuts off the light. This occurs at the half-hour point. In order that the photographic paper may be examined or removed at any time, the windows of the room should be provided with shutters, through one of which red light may be admitted.

The instrument is placed so that the boom is in the meridian, or pointing north-south. It is given a certain sensibility, which increases as the period of its swing increases. To this end it is adjusted for a pendulum swing of 15 seconds, counting a double swing. The clock-box is run on rails in and out of the instrument, and has a cover which is removed to wind the clock and replace the paper on the roll. Generally a 35-foot roll of bromide paper is used, wound upon a cardboard cylinder, so as to be easily put into place. If desired, the watch movement for recording the time can be replaced by an electric device. The marks can be made by an electro-magnet connected with a regulator clock giving contacts of 15 or 20 seconds interval. The paper strip is developed once a week in general.

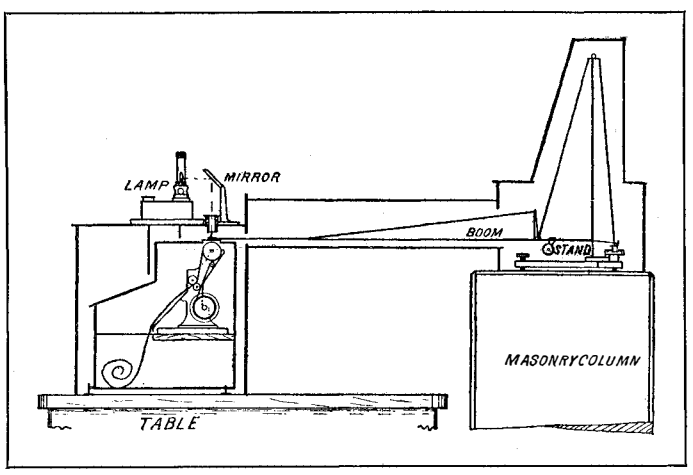
The information required for a seismogram is the date on which it was obtained, the Greenwich mean



Record of the San Francisco Earthquake Made by the Stiattesi Recorder at the Quarto Observatory.

times for the commencement of a decided motion and of a maximum motion. By taking the time between the first preliminary tremors and the first maximum, we may infer the distance of the origin of the shock from the observing station.

Prof. Milne states that this type of instrument has now been installed in no less than forty-five different observatories, which are engaged in co-operating in this work, and it is hoped that some important data will be secured, so as to throw some light upon the many obscure points relating to earthquakes and volcanic action. Besides the leading countries of Europe, we find the apparatus set up at observatories in Ceylon, Egypt, Honolulu, India, Java, Japan, New Zealand,



Section Through Milne's Photographic Recorder.

Canada, South America, Syria, and others. In the United States it has been installed at Swarthmore College, Philadelphia, and at the Johns Hopkins University of Baltimore.

Besides the apparatus which we have just described for obtaining a photographic record, the Shide Observatory is also equipped with a type of mechanical recorder devised by Prof. Milne. It also works on the horizontal pendulum principle, but in this case the diagram is traced in the usual way by a needle point upon a revolving drum, and the glass needle traces the vibrations upon a surface of smoked paper. This instrument is shown in the accompanying photograph, and it is of interest to observe that it traced the record of the San Francisco earthquake. The vibrations were recorded 15 minutes after the disturbance commenced at San Francisco, and again at 40 minutes after the earthquake. It is inferred that in the first case the vibrations were transmitted directly through the earth, while the later ones traveled around the circumference.

In this connection we also give some of the results which have been obtained by the well-known Italian authority, Director Rafaello Stiattesi of the Geodynamic Observatory, which is located not far from Florence, and is well equipped with the most improved forms of seismographic apparatus. With his latest form of seismograph he succeeded in securing a very clear record of the San Francisco earthquake. It was secured by the new Stiattesi horizontal pendulum apparatus having a mass of unusually heavy weight, this being no less than 1,100 pounds. He uses a lever arm which magnifies the vibrations 50 times, and they are recorded on a wide moving strip of smoked paper which is unrolled before the needle by clockwork at the rate of 70 inches per hour. With this apparatus he recorded the first tremors of the earthquake and at some time afterward, the principal movement. Here the instrument gave a swing of no less than 18 inches, or 9 inches on each side of the center. Director Stiattesi, owing to the great clearness of the records and his long experience in this science of which he is one of the chiefs, has made an advance in the question of earth disturbances, having established a formula for calculating the distance of the disturbance point by means of the diagrams. To show how close his formula works, he states that his calculations from the diagrams gave the distance from the observatory to San Francisco, which is 6,158 miles, to within 2 miles. His new instrument, which is shown here, consists of an iron bracket suspended on pivots from the wall and carrying a heavy weight on the outer arm. The arm carries a light pointer, which works against the short arm of a light aluminium lever, and the latter traces the record on a cylinder or a roll of smoked paper.

One of the most important centers of seismological work in Italy is the Ximeniano Observatory, also near Florence, which has been brought to the first rank by the researches of Director Guido Alfani. We give a view of the new recording instruments which have been designed by this eminent scientist. They follow the same general lines as those which we have just described, but contain many improvements in detail. One of the views shows a double instrument consisting of two horizontal pendulums carrying very heavy weights. Both needles trace the records on the same sheet of smoked paper, and the two pendulums are placed at right angles to each other.

The success of these instruments depends upon the method of suspension and the pivots of the pendulum arm, and especially upon the mechanical movement of the light recording lever. In the Stiattesi and the Alfani instruments are found many ingenious details which required a long study, but we cannot at present describe these fully, except to mention a great improvement which consists in connecting the pendulum arm with the short arm of the recording lever by means of a magnet joint, where the magnetism of a small iron rod holds the two pieces together and at the same time allows a free play between them.

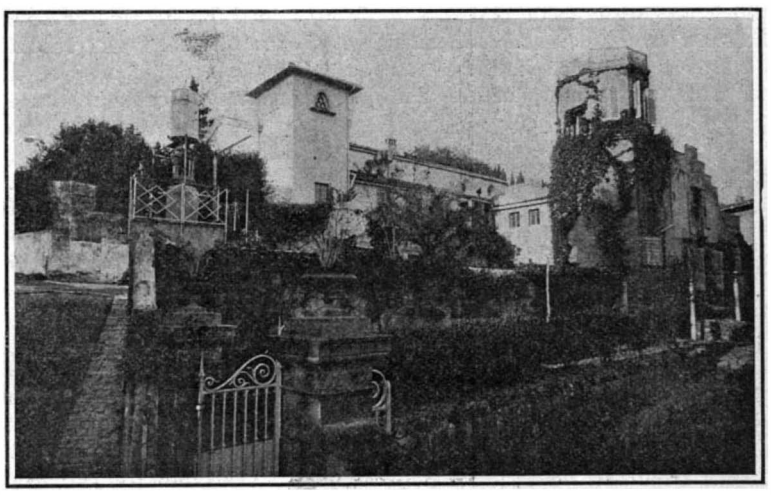
These two Italian observatories have secured some very fine records of the Calabria earthquake, also those of Russia, Formosa, India, and others, from which it is hoped to make calculations which will add greatly to our knowledge of these phenomena.

Is There a Cure for Color-Blindness?

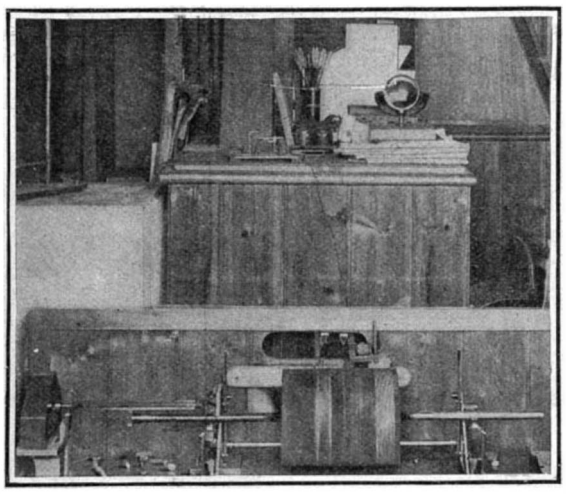
The question came up recently, according to the Central Zeitung für Optik und Mechanik, if the use of rosalin colored glasses sometimes recommended was a certain cure for, or help in, the case of that class of color-blindness in which red and green cannot be distinguished from one another. This question is answered in the periodical named, by Herr Pichon, of Cologne, in the negative, but with some reservations.

Color-blindness is inborn; and it is impossible by means of glasses of any special color or kind to implant in a color-blind person that sensitiveness to color with which Nature has not endowed him. The fault lies with certain fibers in the retina. There is, however, a means by which even the perfectly color-blind can be enabled to recognize and distinguish every color, and even every shade of every color—without, however, being able to distinguish the colors as can the normal eye. This help is based on that principle of any colored glass, by which it permits most easily the passage of those rays which correspond to its own color; and tends to arrest all rays of the complementary color. Those who are color-blind to red and green cannot normally distinguish between these colors, both of which appear to them

yellowish or bluish. If, however, one afflicted with this species of color-blindness looks at both red and green objects through a red glass, he will at once note a difference in the two colors, in that the red appears unweakened in brightness. In other words, red objects will appear to him lighter, while green rays will be absorbed by the red glass and hence green objects seen through it will appear to him darker than when seen with the naked eye. As a complement to this, the red-green color-blind person will by the use of green glasses see objects that are really green brighter than with the naked eye, while red objects seen by him through the same green glass will appear to be darker than when viewed with the naked eye alone.



The Buildings of the Quarto Observatory.



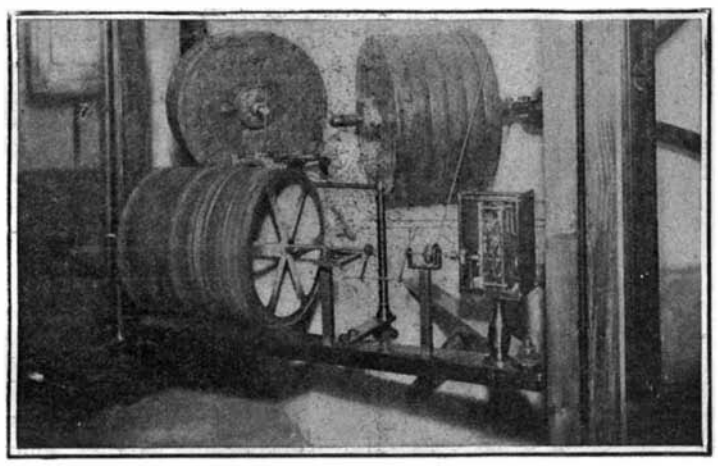
Milne's Mechanical Recorder Which Gave a Record of the San Francisco Earthquake.

If we ask one who is color-blind to red and green what color certain well-known red and green objects have—as for instance the foliage of an ordinary cherry tree and the cherries thereon—he will answer correctly, because he has heard from others what the colors of these objects are. But if we give a red-green color-blind person either red or green glasses, he can by their aid tell what color he observes, by the degree in which the glass affects the brightness of that which he sees.

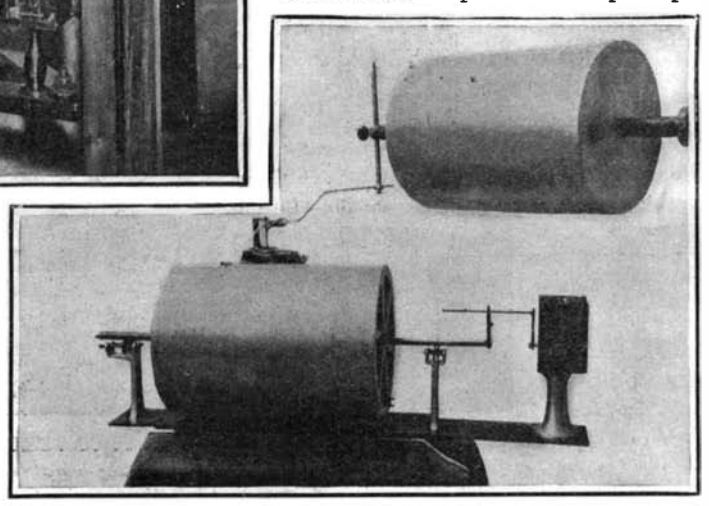
In the same way one who is color-blind to yellow and blue can be helped to distinguish these colors, by means of either yellow or blue glasses, although otherwise undistinguishable. Through the yellow glass, yellow objects will appear brighter than with the naked eye alone; and conversely, the use of a blue glass will brighten to him all really blue objects and dull the brightness of all that are yellow.

As regards those who are color-blind to all colors, they are only to be helped by a set of three different glasses—red, green, and violet. If one who is color-blind to red and green wishes to be able to distinguish between the various shades either of red or of green, the proper course is for him to supply himself with a set of three or more glasses, mounted in the manner of the lenses in a pocket microscope. If in looking through these at a red or a green object he notices no difference in brightness, no matter through which of the glasses he observes it, then he must look again through two of the glasses at once—side by side—until he does observe a difference.

In case a totally color-blind man wishes to distinguish slightly differing shades of color, he must make combinations of red and violet, blue and green, yellow and orange glasses, and with these combinations he can distinguish twelve different shades. In this case it will be best to have the glasses set in pairs, each of the above-named combinations in a frame by itself. Of course these helps are of no use for railway men, or those whose duty it is to observe the colors of signals at sea; as in their case the use of such appliances is not admissible. In conclusion it may be remarked, that there is a special kind of color-blindness caused by a disease of the retina, and which results in the inability to distinguish blue at all, and one of the optic nerve, which results in total inability to see red.



Double Horizontal Pendulum Designed by Guido Alfani.



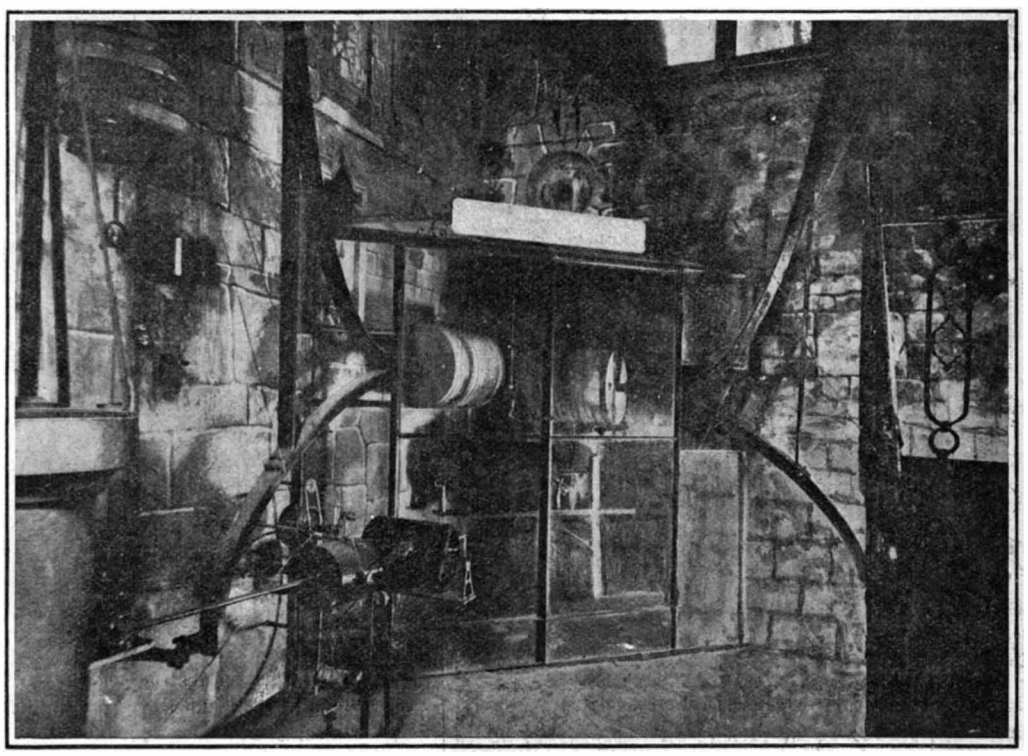
Stiattesi Seismograph. The Weight is Carried on a Swinging Arm and is Connected with a Light Lever-Arm Tracer.

All tests that have been made show conclusively that it is the materials containing the largest number of air cells or dead air spaces that give the most efficient results as non-conductors of heat. Durability is also an important factor, and should be duly considered when selecting a material, as some good non-conductors which would be fairly durable on low temperature work, would be useless on high temperatures.

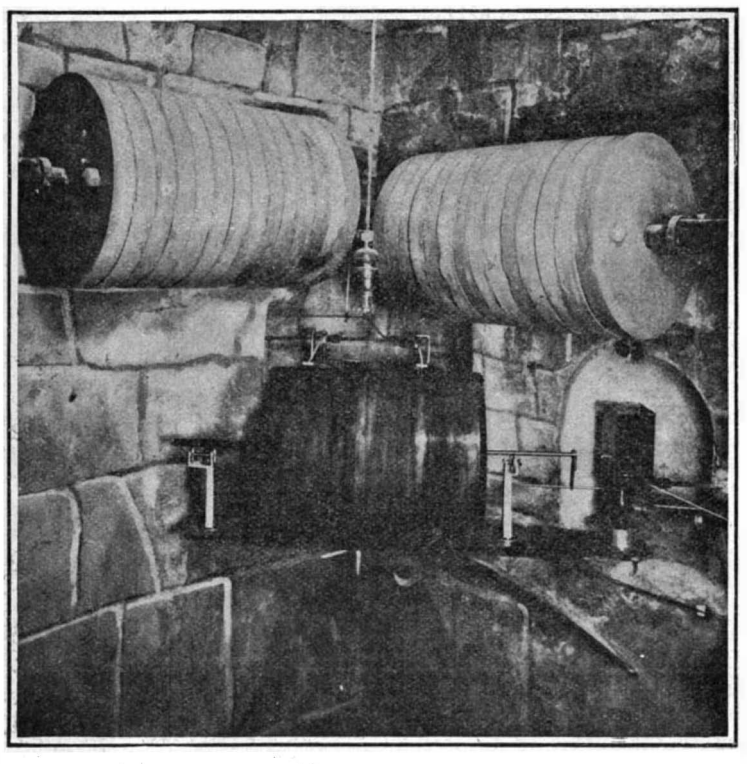
Danger of Relying on Secrecy to Protect a Process.

Some years ago the Goldschmidt Company, of Essen, Germany, perfected a process of detinning tin scrap, but instead of patenting the process they depended on secrecy to make it profitable. The usual result of such practice followed. Two of the employés knowing the secret, proved unfaithful and sold their knowledge to a concern which commenced the work in Holland and from there it was brought to America. The American concern in turn was served in the same manner. The result was that undesirable competition was established by two plants, one at Paulsboro, N. J., and the other at Joliet, Ill. The company first on the ground in this country commenced suit against the competitor, seeking to enjoin them from using the knowledge obtained through the defection of one of their employés. The case was thrown out of court, as the court would not stain its hands with such disreputable proceedings, none of the parties having good standing. The operation of a plant on the principle of secrecy puts a premium on dishonesty. The patent laws of most countries offer adequate protection for most inventions and discoveries; if that protection is not sought, but rather that of secrecy, the possibility of recovery of damages in case the secret is stolen by competitors is very slight indeed.—Machinery.

According to the American Manufacturer, the coal deposits of North America are estimated to contain nearly as much as those of Europe, or 681,000,000,000 tons, but even this gigantic figure is completely dwarfed by Asia's wealth of coal, as to which it is at present impossible to make an even approximate estimate. China more especially seems to possess inexhaustible supplies, and a German scientist has put the coal deposits of the province of Shansi alone at 1,200,000,000,000 tons.



Double Horizontal Pendulum Seismograph Designed by Stiattesi of the Quarto Observatory.



Detail of Stiattesi Double Seismograph.

EUROPEAN EARTHQUAKE RECORDERS.

TEMPERED DUCTILE METALS.

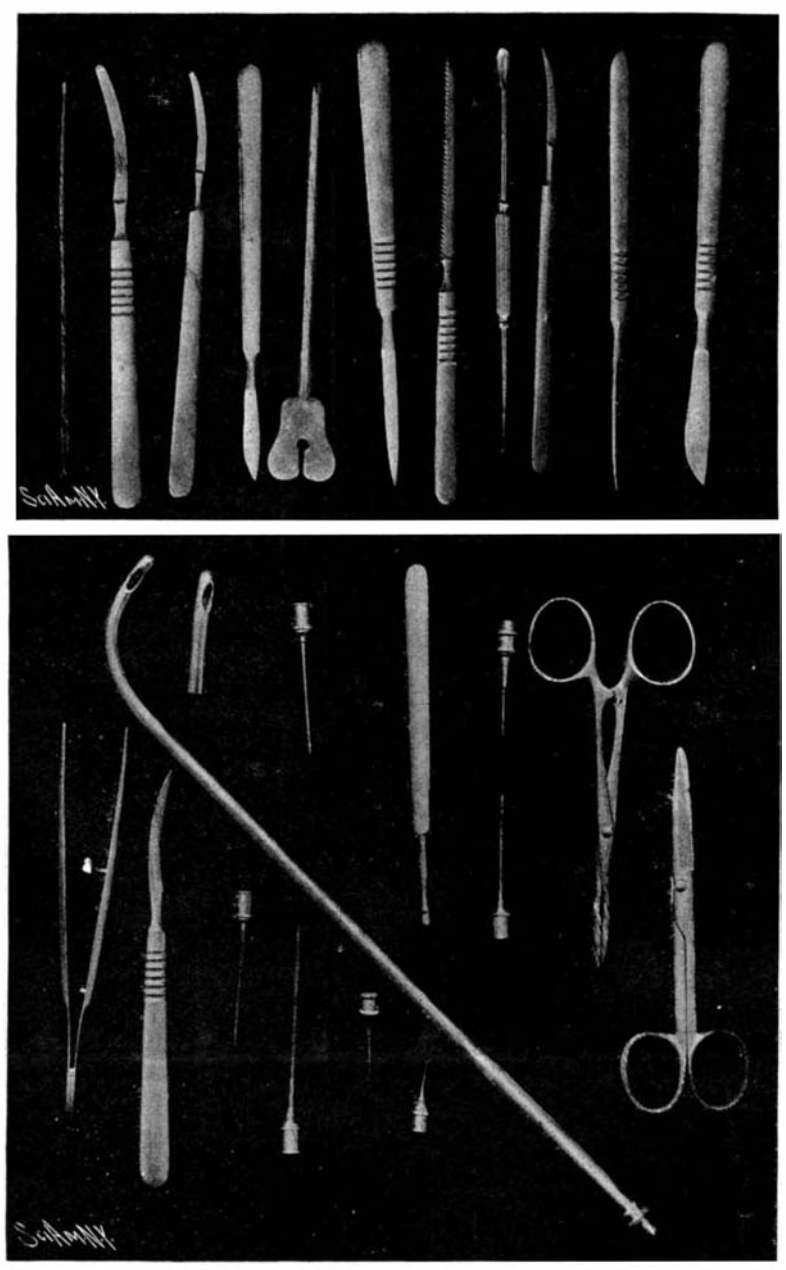
BY ARTHUR F. BRESLER.

A process of tempering gold, silver, and copper has been discovered by Mr. Z. F. Vaughn, of Los Angeles, Cal. By his method of tempering, it is claimed that the ductile metals are not only hardened, but their density and homogeneity are brought to such practical perfection that a cutting edge is given keener and more durable than that of steel, because of the microscopic fineness and smoothness imparted to it.

The inventor's experiments were devoted chiefly to the manufacture of surgical instruments of gold, his first production being a hypodermic needle of solid tempered gold. He has added to this all the instruments now in use in modern surgery. Prominent surgeons have given these instruments practical tests and in every case the results, it is said, were entirely satisfactory. For surgical purposes, the inventor claims that instruments of tempered gold are superior to those of steel, because of their non-corrosiveness and the ease with which they may be sterilized. The antitoxin needle is about two inches long and the needle for spinal anæsthesia is about three inches long. There is no clogging; consequently it is not necessary to use wire. The needles are easy of introduction, the largest size passing through the tissue more readily than the smallest steel needle. As the needle is entirely aseptic, it leaves no mark. All wearing surfaces are solid gold and may be either 24 karat or any degree of alloy. The secret of the process appears to be in the solution used in tempering.

The inventor states that tempered copper is not subject to that crystallization through vibration which limits the life of steel; that springs of tempered copper have not only as great elasticity and strength as steel springs, but that owing to the extreme slowness of the process of crystallization, they will retain the spring temper for a practically indefinite period. It is expected that a most extensive use of tempered copper will be made for journal bearings. Owing to the great density of the metal, it takes a perfect polish with use and makes an almost frictionless bearing, free from danger of overheating, and outlasting either Babbitt metal or brass for the purpose.

Under a microscope, a razor manufactured by Mr. Vaughn showed a much smoother edge than a steel razor, and a test proved that it held its edge longer.



SURGICAL INSTRUMENTS OF TEMPERED GOLD.

WELLMAN'S MOTOR BICYCLE SLED.

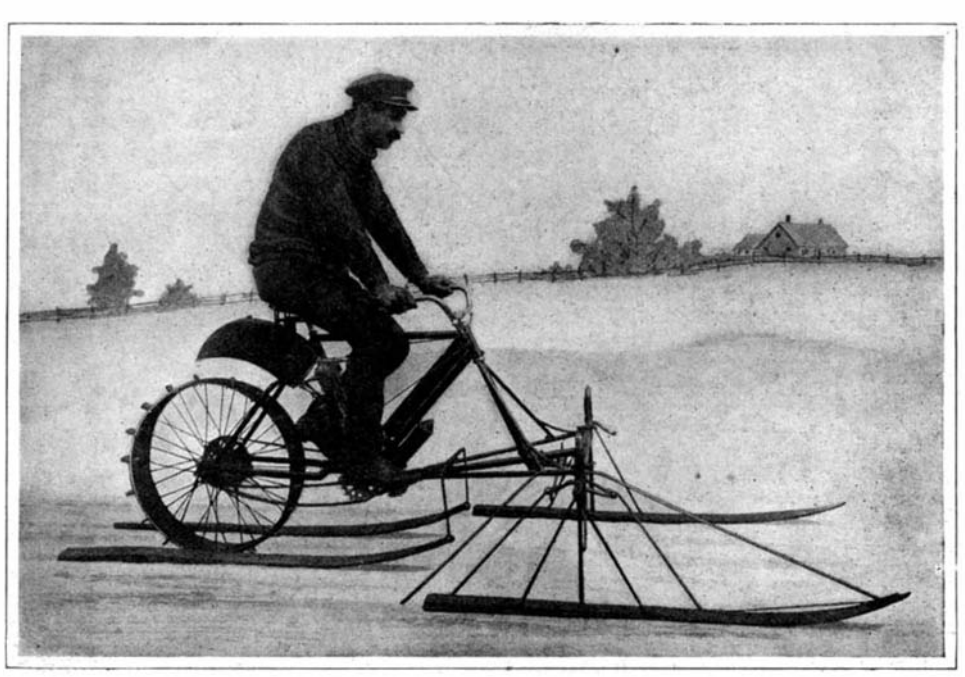
Before leaving for Paris to arrange for the construction of his polar airship, Walter Wellman sent a representative to interview the automobile people of the country, select the best and make a contract for the building of a trial motor towing machine. The experience was disheartening. Almost every prominent concern had more orders on hand than could be filled, in which there was an assured profit, and to undertake an experimental machine such as Wellman wanted "would throw the entire factory out of its stride."

After weeks of vain effort Wellman's representative returned to Washington, enlisted the interest and cooperation of Charles M. Miller & Bro., who detailed George W. Wells, an automobile expert and a man of much originality of thought, to build the machine. In a stable in an alley-way in the northeast part of the city, where the desired secrecy could be had, the work was begun and finished.

The motor and tri-car frame used were secured from a motor bicycle maker, but everything else was constructed by hand under Mr. Wells. The motor is of 4½ horse-power. It is intended for towing solely and not for speed and therefore is geared low. The machine can travel from two to thirty miles an hour over smooth ice.

The runners used are of two pairs of Norwegian "ski," both having seen actual service in the north on Wellman's two former trips and having been worn by Wellman himself. The wood is therefore seasoned and can be relied upon. They are reinforced, however, with sheet-iron, underneath which are steel runners or skates. The front "ski" are the guides; the rear ones being used to take some of the weight from the tractive or driving wheel when soft snow is encountered, which is frequent enough in the frozen North to make such a provision necessary.

The driving wheel is quite an interesting bit of mechanism, and is Mr. Wells's invention. It is constructed entirely of steel except for the rubber tire. The width of the wheel proper is about six inches, on the outer edge of which are broad teeth that are to give the power in the snow or soft ice. In the center is a pneumatic tire of rubber two inches wide. This is covered with steel wire to prevent puncture, and this latter is covered with a strip of leather which is filled with sharp steel teeth about the size of the head of an ordinary screw, that will grip the hardest ice and, as Mr. Wells put it, will climb the side of a house.



WELLMAN'S MOTOR BICYCLE SLED.

The steel chimney of largest diameter in the United States is at the smelting works of the Copper Queen Consolidated Mining Company, at Douglas, Ariz. This is 200 feet in height, 25 feet internal diameter, and 34 feet diameter at the base. The steel chimney of the Compania Minera de Penoles, at Mapimi, Mexico is 300 feet in height, 14 feet internal diameter, and 24 feet in diameter at the base.

Sociological Effects of the Telephone.

The "oyster king" of New York city has just been "put out of business" and has lost his monopoly of the trade because of the telephone. The connection between cause and effect, and the bankruptcy of the bivalve monarch is thus explained: Instead of going over to the docks on the Hudson River to buy oysters nowadays, the big hotel and restaurant managers simply ring up the oyster planter on the telephone and order oysters direct, or give the order to the oyster agent, who telegraphs it to the planter. Then the oysters arrive by railroad train. That, they say, puts the oyster barge business "in bad," and forces many of the old-time barge captains to the wall. The telephones have wiped out the middle man or jobber. Consequently many of the old wholesalers have been driven out of business, and instead of twenty or thirty oyster barges lined up along the North River piers, there are now two or three at the foot of Bloomfield Street.

Another sociological or economic effect of the telephone is noted by the Boston Herald as follows: "Even the rural mail carrier is in a measure anticipated by the telephone in many country districts. Now the farmers on the circuit in the Western States, where enterprise is a 'hustler,' and innovations are welcomed instead of being fought, are to receive at least once a day, and perhaps twice, all the important news of the world. The system, it is said, 'is being installed in Minnesota, Iowa, and South Dakota, and within six months will be in vogue wherever telephones are used in the rural districts. Not only this, but every schoolhouse will be connected, and while the service is being transmitted a recess will be had, after which the teacher will impart to her pupils the news of the forenoon. The farmers will have an added advantage, for they will get the news twice a day—at noon and at 7 o'clock in the evening.' At first it was thought this would injure the circulation of newspapers, but the reverse is proving true. The appetite for news grows by what it feeds on, and as the telephone operator can give in a twenty-minute talk only a mere bulletin of the news, the daily or weekly paper with 'the particulars' is eagerly waited for. 'The most notable result of the news service,' says the manager of a rural telephone line, 'is the increase in subscribers, and our merchants note a corresponding increase in telephone orders for goods to be sent by the rural mail carrier, while the farmer's visits to town have become less frequent, and are now seldom made when he is not going to market with his produce.' "—Electrical World.

The big trainshed seems to be a thing of the past. The initial cost of these gigantic structures, and that of maintenance, grew out of all proportion to the increase in the dimensions, and the present practice seems to indicate that the last of them has been seen. Besides their actual utility, the great train span was considered to have some advertising value, and it was no common thing to see announcements made that this or that railroad was to have the greatest trainshed in the world, but the limit of their usefulness has been reached. The cost of keeping these sheds in repair grew to be a very serious item, and another drawback charged against them was their inadaptability to enlargement as it was found necessary to increase the number of tracks. What is known as the "umbrella shed" is taking its place. The umbrella system consists of a number of smaller sheds, each protecting the passageway between two trains. They are supported in the center, which explains their name. The roof is flared upward at the edges, so that the rain will be drained toward the center, where accommodation is made for it to be carried off through the supporting pillar. A great portion of the shed roof consists of wire-glass to admit the light. Besides the economies of this new method, its possibilities of expansion in either direction are almost unlimited. It can be readily made longer as desired at any time, and as new tracks are added to the terminal facilities, it is simply necessary to add a shed or two. This has been adopted by the Lackawanna Railroad Company for use at Hoboken, N. J., and will also be made use of in the future by one or two western roads.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

GARMENT-SECURING DEVICE.—J. E. RHODES, New York, N. Y. The invention pertains to devices for securing garments in place, and more particularly to those adapted for use in connection with skirts and shirt-waists. Its principal objects are to provide such a device which will hold the skirt from sagging and the waist from crawling and which will also draw down the front of the waist to give the pointed effect.

BUCKLE.—L. SANDERS, New York, N. Y. The purpose of the inventor is to provide a buckle especially adapted for the back-straps of trousers, vests, and other garments in which straps are used, but which may be employed wherever a friction bite is desired, and to improve the construction of the buckle over that formerly secured to Mr. Sanders by Letters Patent.

Electrical Devices.

AUTOMATIC INSULATOR.—G. M. CORELL, New York, N. Y. This improvement relates to automatic insulators and closers for electric circuits. It is to be used especially in connection with line-wires carrying electric currents; the object being to provide means for automatically cutting out the broken end of a tightly-strung conductor, such as a line-wire. It provides a circuit arrangement whereby the flow of current in its circuit may be uninterrupted although the circuit has been severed at any point.

Of Interest to Farmers.

MILK-PAIL.—G. A. JONES, Ottawa, Kan. The object in this improvement is the production of a pail having a strainer attachment which will substantially close the mouth of the pail and protect milk from falling dirt and insects. The strainer may be readily removed or replaced. The invention relates to milk-pails, such as used on farms when milking.

Of General Interest.

COLLAPSIBLE SCREEN.—L. DEJONGE, JR., New York, N. Y. In the present patent the intention of the inventor is the provision of a construction of screen whereby it can be rolled up, making a small package for storage or transportation, and whereby also it can be quickly, conveniently, and firmly set up for use.

NON-REFILLABLE BOTTLE.—G. C. ALLEN, Port Townsend, Wash. From this very simple bottle the contents may be poured at will but it cannot be refilled fraudulently. By reason of the offset position of the inclined duct it is impossible for an instrument to be applied to the upper portion of the liquid-valve in order to open the same to allow a liquid to pass inwardly. This mechanism and bottle can be made for a cost of about ten cents.

WOVEN FABRIC.—H. SARAFIAN, Yonkers, N. Y. In this instance the object is the provision of a new and improved woven fabric designed for use as carpets, rugs, and the like and arranged with an exceedingly strong back to give the desired lateral stiffness to the fabric and to insure a soft tread.

COAT, HAT, AND UMBRELLA LOCK.—R. H. HEBERLING, Wilmerding, Pa. This inventor provides a combined holder for a coat, hat, and umbrella, the devices for holding the garments and umbrella and the hasp having spring acted pawls controlling the same within the containing case, and the arrangement is such that a single key serves to release the several pawls at one operation.

DIE.—J. J. BROSSOIT, Salt Lake City, Utah. The underlying object of Mr. Brossoit is to construct a single die formed of two members which may be used to perform all of the upsetting or hammering operations necessary in the construction of the drill. In attaining this end he provides a single die with two peculiarly-arranged working surfaces, so that by changing the position of the work in the die either one of two distinct operations may be performed.

Hardware.

COMBINATION-TOOL.—S. MORKERT, Querida, Col. This tool is especially useful in the construction or repairing of wire fences. It is manipulated as a wire-cutter and hammer and operates in this connection substantially like an ordinary hammer. Used as a screw-driver, the hammer-head operates as a handle to facilitate using of the driver. If leverage is not sufficient the lever of the cutter may be thrown out from the handle and used as a lever to facilitate the turning of the driver.

CHECK ATTACHMENT FOR PULLEYS AND CHOCKS.—R. KURELLA, Brooklyn, N. Y. A purpose of this improvement is the provision of an attachment to chocks, leading-pulley blocks, and the like which can be set to permit the free passage of a rope through the chock or pulley or set to clamp the rope in such manner that at such time the more strain to which the rope is subjected the tighter the attachment will hold the rope.

Household Utilities.

RECLINING-CHAIR.—J. LANDAU, New York, N. Y. In this patent the object of the invention is the provision of a new and improved reclining-chair arranged to allow the user to readily move the hinged back into an inclined position to suit the convenience of the user. Means allow the fitting of the operating mechanism on chairs of different sizes and construction.

FOLDING FURNITURE-LEG.—L. B. JEFFCOTT, New York, N. Y. The invention resides in peculiar features of construction and arrangement concerned with the provision with two legs or supports, of links respectively pivoted to the legs and extended toward each other, their adjacent ends being connected by a rotatable member of such arrangement that the parts may be thrown into either extended or folded position and held securely in either position.

PICTURE-HANGING DEVICE.—L. HORINKO, New York, N. Y. The device is especially adapted for hanging heavy pictures. They may be conveniently and expeditiously lowered to the floor without detaching them from their supports and quickly restored to their normal position on the wall, or the pictures may be adjusted up or down on the wall and held securely in adjusted position. The device supports a picture at the bottom as well as at opposite sides of the back.

Machines and Mechanical Devices.

TILE-MOLDING DEVICE.—H. BESSER, Alpena, Mich. In the present patent the invention has reference to a device for simultaneously molding a plurality of tiles in vertical position. The principal objects of the improvement are the provision of a simple form of mold for this and similar classes of work and to provide an efficient mechanism for operating it.

MOLDING DEVICE.—H. BESSER, Alpena, Mich. This device carries out the "hand" method of molding building-blocks and other articles from plastic material. The mold, which constitutes most of the device, is manipulated by hand to form a molded article; and the principal objects of the present invention are to provide means whereby manipulation of the handles used for lifting the mold will result in automatically and simultaneously withdrawing all the mold-walls from the surfaces of the molded article before the lifting operation is commenced, whereby these operations are made practically continuous one with the other.

MOLD FOR HOLLOW ARTICLES.—H. BESSER, Alpena, Mich. In this case the invention refers to a mold for hollow articles, especially that class which are molded in a vertical position—as, for example, drain-tiles and the like. The principal object of the invention is to provide means whereby an expansible core can be readily and positively expanded and contracted by a very simple motion and to provide for this in a simple and convenient manner.

ALARM.—F. M. HOBBS, Halesboro, Texas. The object had in view in this invention is to provide an alarm for attachment to windows, whereby upon raising the lower sash thereof or lowering of the upper sash a bell forming part of the alarm will be sounded, indicating to inmates of the house that a burglar or other person is attempting entrance thereinto through the window.

PILE-FABRIC LOOM.—J. K. DALKRANIAN, New York, N. Y. The aim of this inventor is to provide a loom more especially designed for weaving woven pile fabric—such, for instance, as shown and described in his former application for Letters Patent of the United States. The loop-forming devices for the pile warp-threads, the tension device for drawing the loops tight around the weft-threads, the beating-in mechanisms, the heddles, and the shuttle mechanism all operate in unison to produce the results intended by the improvement.

Prime Movers and Their Accessories.

WAVE-MOTOR.—D. H. MOWEN, Myersville, Md. The motor is designed to be operated by the action of the waves or tide; and it consists in the novel construction and arrangement of parts in which a weight is raised by the action of a float as a source of power and in which a construction of gears is arranged to transform the movements of the float into a continuous rotary motion for any useful purpose.

OILER.—D. HERRMANN, Guttenburg, N. J. The improvement pertains to oilers and admits of general use, but is of peculiar value in relation to oiling of wrist-pins, high and low-speed engines, and other prime movers. It is based upon the principle that a falling liquid is unable to follow a line of continually-changing direction at high speed.

Pertaining to Vehicles.

BUGGY-BOOT AND FASTENER.—P. J. BLASER, Fostoria, Ohio. One of the objects of Mr. Blaser's invention is the provision of a buggy-boot so constructed that it will be waterproof and padded, enabling it to be utilized as a seat, and so that it will be strong enough to support objects of considerable weight.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

A SIMPLE ADDING MACHINE.

The accompanying engraving illustrates an adding machine which, unlike most machines of this class, is the acme of simplicity. It consists of a square plate beneath which a large disk is mounted to revolve. The disk is provided with a ring of numbers running from zero to 99, the numbers showing through a slot in the base-plate. The disk is perforated along its periphery. Nine wider holes, which are large and pear shaped,

serve to guide a wire point, secured to a pencil, into the proper perforations of the disk when the machine is being used; thus its operation is made very simple and positive. That the machine is the result of experience is shown by the employment (and their convenient arrangement) of only nine numbers for the operator to use, which reduces chances for mistake, as well as making the operating very easy.

The Eagle Adding Machine Company, 106 Wall Street, New York, are the manufacturers.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 8149.—Wanted, address of Follett Steel Numbering Machine Co.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 8150.—For machines for wall paper preparing.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St. Chagrin Falls, O.

Inquiry No. 8151.—Wanted, address of firms installing alcohol lighting.

I sell patents. To buy, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 8152.—For manufacturers of celluloid glue.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company. Foot of East 138th Street, New York.

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Metal Novelty Works Co., manufacturers of all kinds of light Metal Goods, Dies and Metal Stampings our Specialty. 43-47 S. Canal Street, Chicago.

Inquiry No. 8154.—For manufacturers of rubber stamps made to order.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery tools, and wood fiber products. Quadriga Manufacturing Company, 18 South Canal St., Chicago.

Inquiry No. 8155.—For manufacturers of thermometers registering as high as 600 deg. F.

Automobile experts are in constant demand at high salaries. Our seven weeks' course is the most thorough and practical, fitting men to drive, handle and repair Day and evening classes. Special course for owners New York School of Automobile Engineers, 146 West 56th Street, New York.

Inquiry No. 8156.—For manufacturers of crimped elbows, 2¾ inches in diameter, from sheet copper, 10 ounces.

Inquiry No. 8157.—For manufacturers of roller window and door screens.

Inquiry No. 8158.—For manufacturers of grindstones, such as have bicycle frame with seat and two pedals.

Inquiry No. 8159.—For manufacturers of machines for making men's clothing.

Inquiry No. 8160.—For manufacturers of vending and amusement machines.

Inquiry No. 8161.—For manufacturers of machinery for pressing charcoal into bricks for fuel.

Inquiry No. 8162.—For manufacturers of cheap flexible rubber specialties.

Inquiry No. 8163.—For manufacturers of Artisan Dongaree clothing.

Inquiry No. 8164.—Name and address of manufacturers of American Diamond Light Oil Burner.

Inquiry No. 8165.—For manufacturers of the Graham Safety Lamp Filler.

Inquiry No. 8166.—For manufacturers of overshot water wheel.

Inquiry No. 8167.—For manufacturers of the Gilbert heel cushion; also Eagle Claw fish trap.

Inquiry No. 8168.—For manufacturers of compressed air meters.

Inquiry No. 8169.—For manufacturers of machines, tools and instruments for the construction of farm drainage systems.

Inquiry No. 8170.—For manufacturers of carpet-cleaning wheel or other machines, also makers of feather-renovating machines.

Inquiry No. 8171.—For manufacturers of machines for making straw brooms and root brushes.

Inquiry No. 8172.—For manufacturers of the magnetic compass, such as is used in watch charms.

Inquiry No. 8173.—For manufacturers of rubber goods, such as tubing, hot water bottles, etc.

Inquiry No. 8174.—For manufacturers of animated toys, such as men, etc.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(10011) C. D. R. asks: Can you give me a receipt for transparent etching ground, for retouching? Silicate of soda is transparent, but leaves a ragged edge in the lines. Is there anything I could add to it for the purpose that would not destroy its transparency? A. Retouching varnish, sandarac 1 ounce, castor oil 80 grains, alcohol 6 ounces.

(10012) F. C. asks: How can I cover a pulley with paper or leather? Pulley is of cast iron 9 inches by 8 inches with an extra smooth face. A. Scratch the face of the pulley with a rough file thoroughly, so that there are no bright or smooth places. Then swab the surface with a solution of nitric acid, 1 part; water, 4 parts; for 15 minutes; then wash with boiling hot water. Having prepared a pot of the best tough glue that you can get, stir into the glue a half ounce of a strong solution of tannic acid, oak bark or gall nuts, as convenient to obtain, to a quart of thick glue; stir quickly while hot and apply to the paper or pulley as convenient, and draw the paper as tightly as possible to the pulley, overlapping as many folds as may be required. By a little management and moistening of the paper, it will bind very hard on pulley when dry, and will not come off or get loose until it is worn out. Use strong hardware wrapping paper.

(10013) DeF. H. asks: 1. How many volts and amperes does the simple plunge battery described in "Experimental Science" give? A. Each cell gives an average of 1.8 volts, so that in series you would have 1.8 × 8 or about 14 volts. In parallel it will give 1.8 volts. The amperes depend upon the external resistance principally, since the internal resistance is very small. You can safely take 4 amperes. 2. How long can this battery be used without decreasing in strength? A. Any battery begins to be exhausted as soon as it begins to do work, of course. You will obtain about 60 ampere hours from the battery, before renewing the solution. The zincs will last a long time, the carbons indefinitely. 3. What would the materials for this battery cost (approximately)? A. If you can make the case, windlass, etc., the cost is much reduced. The jars, plates, and other materials will cost about $15. 4. Directions for making a small and inexpensive Ruhmkorff induction coil giving a 1-inch spark, for use with the two chromic acid cells? A. You will find the directions, full instructions with drawings, in Bonney's "Induction Coils." Price by mail, $1. The coil described in "Experimental Science" is a good one, and gives a longer spark. It will cost but a little more than one giving an inch spark.

(10014) L. E. T. writes: Steel being a conductor of electricity, why is it that the steel balls used in the coherer of a wireless telegraph system, being in contact with one another as they are, do not make a continuous circuit in the receiving apparatus? A. Steel balls in the ordinary sense of the word have not been used in the coherer of the wireless telegraph so far as we are informed. The coherer contains a powder, composed of metal filings. Various metals have been employed simple or mixed. Any powder, even of a conductor, is a very poor conductor. The principal reason is that the particles are *not* in close contact with one another. When an electric wave strikes this powder, its electrical resistance is very greatly reduced, as if the particles had cohered. This state continues till a jar is given to the powder, when the high resistance is restored. See Fahie's "History of Wireless Telegraphy." Price $2 by mail.

(10015) L. A. S. asks: 1. What per cent of electricity, going out through the trolley wire, gets back to the dynamo through the rails or ground? A. All the current returns to the dynamo in one way or another. 2. Would it be possible under existing conditions of insulation, to send the current out through the rails and back to the dynamo through the trolley wire, and if so, would the electrical efficiency be the same? A. The trolley wire is made plus, not as you seem to think, because the current might not go out properly if sent out by the rails, but to protect metals, water and gas pipes, etc., from corrosion as much as possible. It makes no difference to the electrical efficiency which wire is attached

to the trolley, the plus or the minus. If, however, the current flows from the trolley wire to the ground on its way back to the station, it will not act by electrolysis so much upon the metal which it traverses, as if it flowed in the opposite direction. Iron and lead are positive, and tend to attach themselves to the negative pole of the circuit. If then the rails, and water and gas pipes are in the direction of the flow of the circuit, they are not reduced by electrolysis as they should be if the current were flowing the other way, from the rail to the trolley wire.

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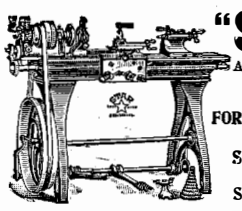

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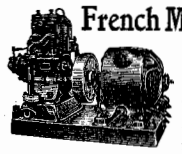
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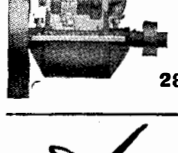
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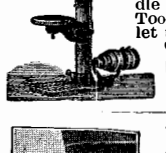
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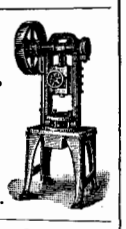

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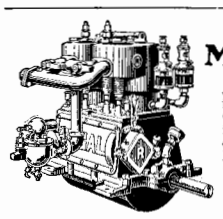
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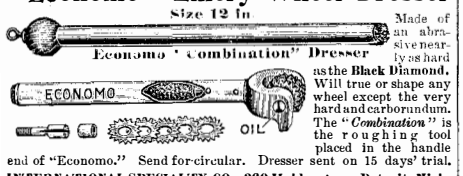

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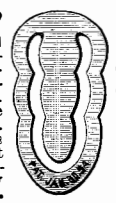

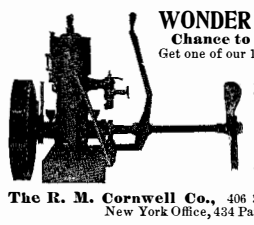

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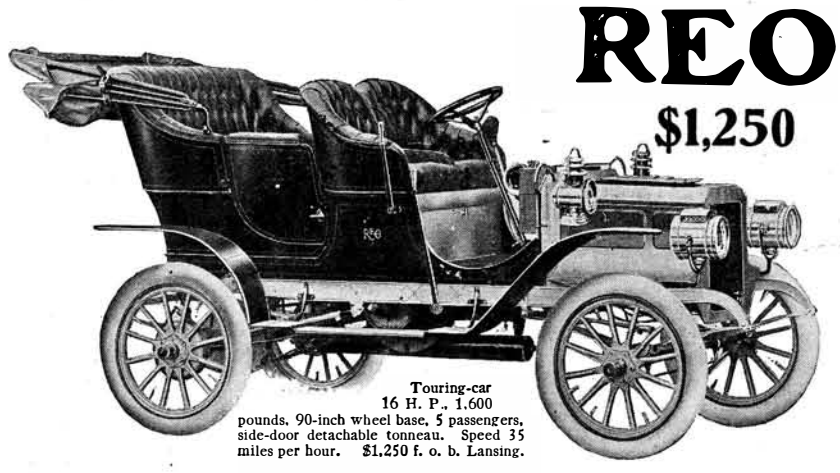

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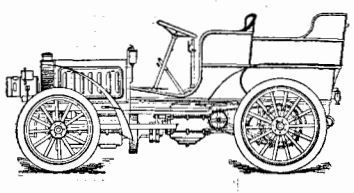

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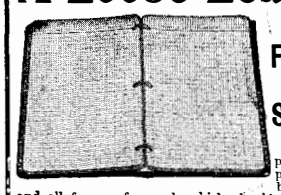

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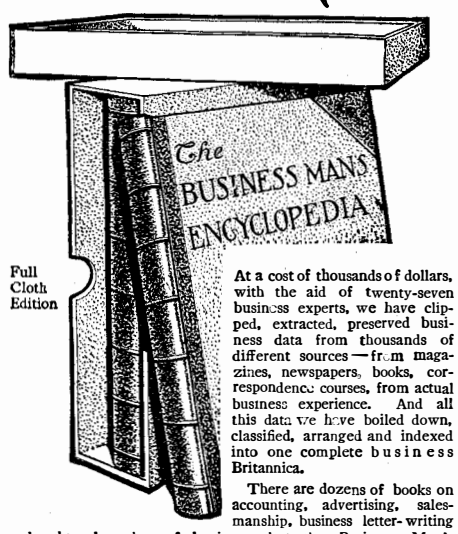

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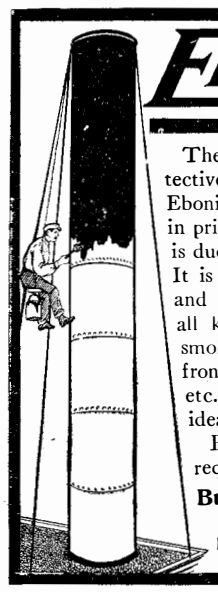

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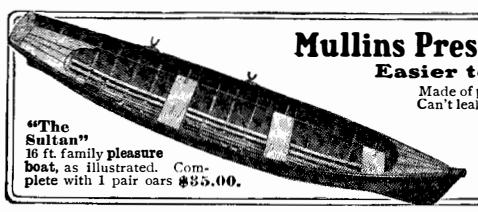

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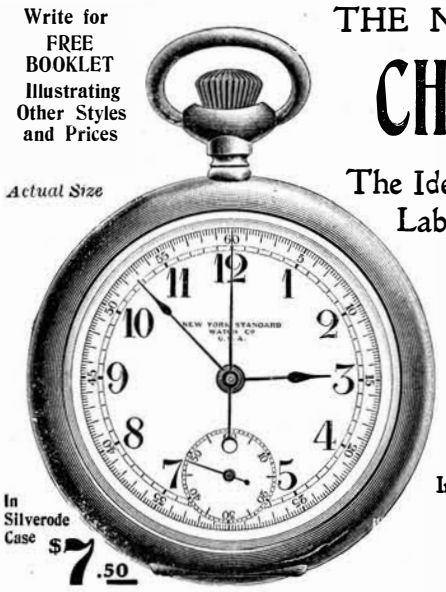

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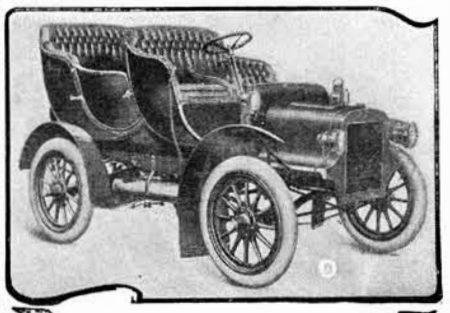

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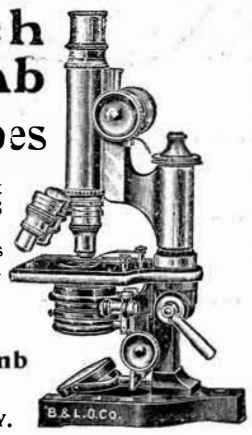

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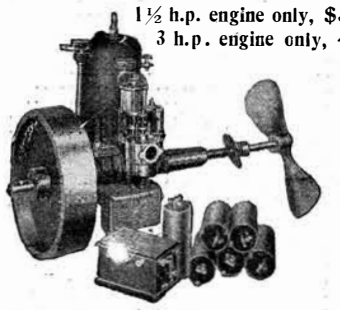

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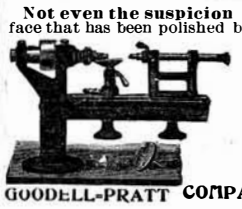

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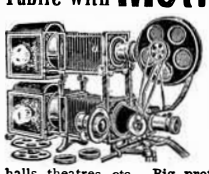

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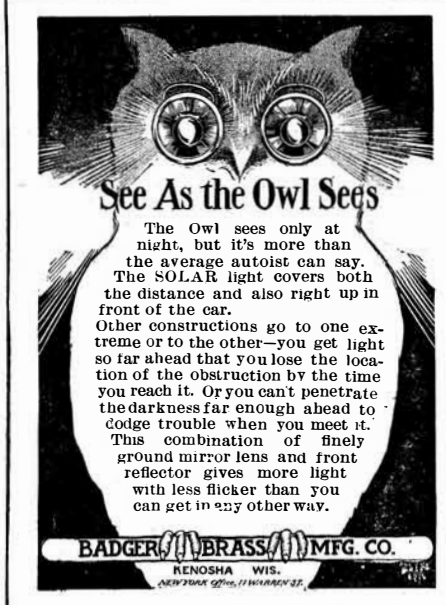
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